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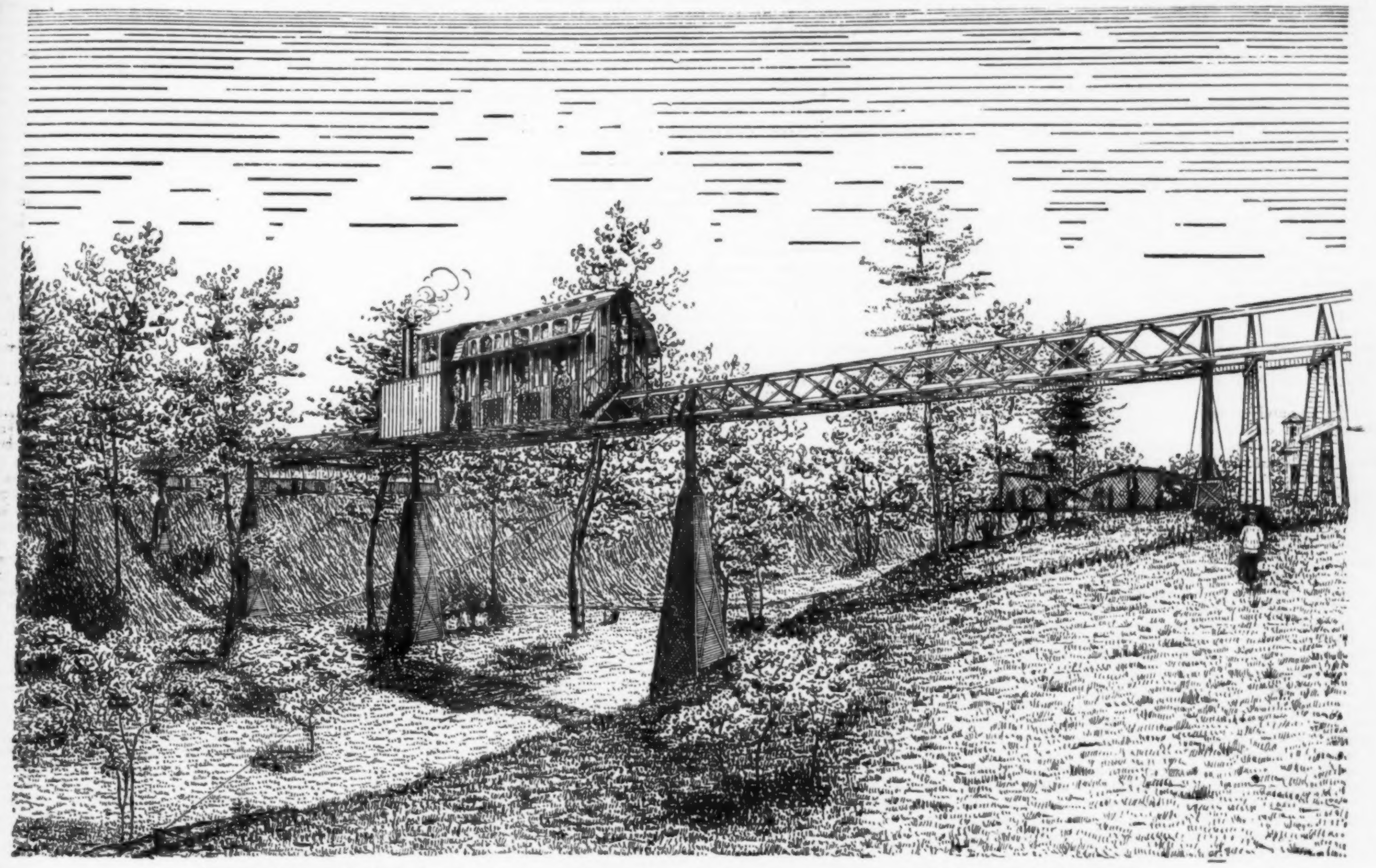
NOTES FROM THE EXHIBITION.

THE SINGLE-RAIL RAILROAD.

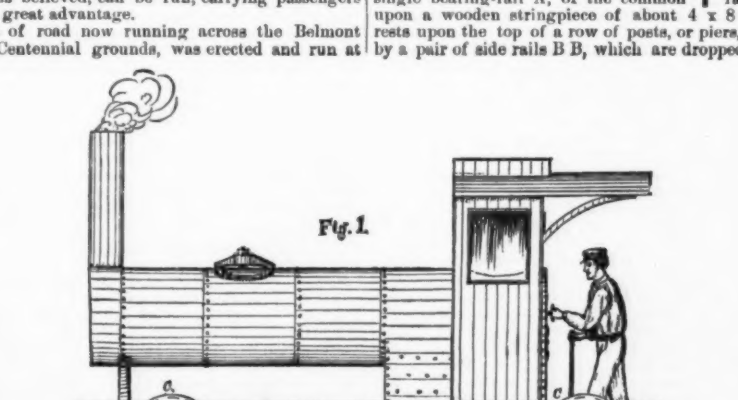
THE section safety railway, erected over the Belmont Ravine in the Exhibition grounds, and herewith sketched, attracts much attention. It is known as the plan of General Le Roy Stone, and is designed for city and country roads. Long trains, it is believed, can be run, carrying passengers or freight, with great advantage.

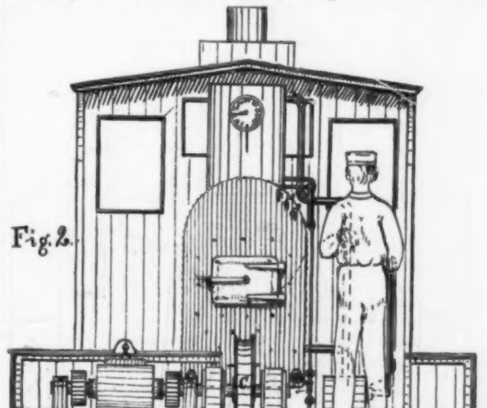
The example of road now running across the Belmont Ravine, in the Centennial grounds, was erected and run at Phœnixville, Pa., and is therefore not an entirely new experiment; on the other hand, it by no means indicates the limit of what can be done upon this principle. This road, as shown in our perspective view, taken on the spot, crosses the Belmont Ravine at an elevation of about 35 feet, and is about 500 feet long, and although laboring under the disadvantages of, to a certain degree, temporary construction and distance from its base of supplies, it is so simple that in passing over the road no one would suppose that it had not been built and in use in this spot for years.

By referring to the perspective and also to the illustrations in Figs. 1, 2, 3, it will be seen that the road consists of a single bearing-rail A, of the common T rail pattern, laid upon a wooden stringpiece of about 4 x 8 timber, which rests upon the top of a row of posts, or piers, and is flanked by a pair of side rails B B, which are dropped some 4 feet 5 inches below the level of the bearing-rail A, and are 3 feet 4 inches from out to out. A system of cross-bracing from the main rail A to each of the side rails, supplemented by a similar set of braces between the rails B B, gives the whole the character of a triangular truss, of great strength in proportion to the amount of material used. The piers that support this track present no especially new features, being themselves open to great variation of character, both in regard to the material used and the form in which it is put up. In this instance two classes of support are shown, the central part crossing the depth of the ravine being mounted upon wrought-iron columns from 12 to 13 feet long, and these stand upon wooden piers framed and boarded, and placed some 40 feet apart; while the ends, where the elevation above the ground is less, are supported by wooden trestles.



THE INTERNATIONAL EXHIBITION OF 1876.—THE SINGLE RAILROAD.





ROLLING-STOCK.

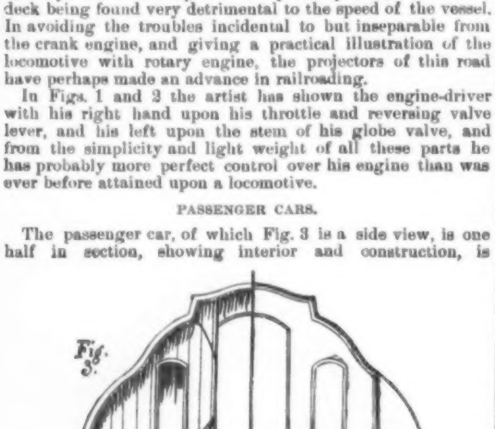
The locomotive—of which a side view is given in Fig. 1,

and a rear view, with casing removed, showing interior of lower portion, in Fig. 2—used upon this road runs upon two driving-wheels, shown at C C, Figs. 1 and 2, of 28 inches diameter; the boiler, of the style known as "locomotive," 12 feet long and 34 inches in diameter, with four and a half foot fire-box, is dropped as low to the bearing-rail A as practicable. The frame of the locomotive is made of angle iron, and drops to the level of the side rails B B on either side, carrying on each side two guide-wheels D D, of 28 inches diameter, which run upon vertical axes. Both the driving-wheels C C and guide-wheels D D are grooved, or, properly speaking, double flanged, making it impossible for the locomotive to be taken off the track by any accident that does not first actually take the wheels off, and then lift the machine bodily nearly five feet, throwing sideways withal. The total length of the engine is only about 17 feet. The fuel and water tanks being below the level of the bearing-rail and upon the side-frames, assist in ballasting and steadying the machine. The engines proper are of the La France rotary pattern, the principle of which is that of two gear-wheels running in a tight case; the main peculiarity in this case being in the system of "packing," which is so made as to allow for the difference of the expansion and contraction of the various parts. Engines of this construction have been running for about four years, giving great satisfaction. In this case they work directly upon the driving-shafts, giving great simplicity of construction and no connections to break on curves. This is claimed as the first running locomotive upon the rotary principle, and, as an illustration of the advantages of this system over the crank-engines, is extremely interesting to all: to railroad men, who figure up the saving in first cost and in wear and tear, both to engine and track, for it is no secret that the crank-engine hammers the rail with every jerk of its pistons, requiring, on account of such pounding motion, larger rails in proportion to the weight of the load, and even then wearing their surface faster than a steadier motion; and also to the invalid passenger, who on this road misses the jerk, jerk, jerk of the crank motion, and the oscillation, which being originally caused in the engine by the fact that the cranks are perforce set, as it is called, "quartering;" and if the one gives its jerk and pound upon the rail on the slightly elastic spot that occurs between two cross ties, and the other replies by a kick upon the firmer spot on the cross-tie itself, it were a wonder if the strokes are ever equal; and indeed it is fortunate that they are not, for such alternate kicking might, if on a perfectly equal road-bed, start an oscillation that, at certain speeds, would so multiply as to make it an impossibility to keep the machine upright, to say nothing of what the stoker correctly calls "jumping the track." These side swings of the engine are communicated through the couplings from engine to car, and from one car to another, the whole length of the ordinary train. In the road over the Belmont Ravine, the locomotive having no crank movement, the greatest original cause of all this jerking and swinging being absent, the whole train runs smooth, and contrary to the common rule, the faster you drive it the smoother and steadier it runs. This comes from the fact that motions in different directions are always antagonistic to each other, and if any article move with great velocity in one direction, it can not move at all in any other—a law beautifully exemplified in the gyroscope, and equally well in a common top which is very top-heavy, but will wiggle around, with the centre of gravity a long way off from the base, as long as the velocity of the rotation is great enough to counteract the attraction of gravitation, and the combat between the two forces is shown in what the boy calls "it's "going to sleep." Again, the side swing on the common roads by the same law increases the labor of the locomotive in maintaining any given speed independently of the increase of friction. This is seen in the yacht or cat-boat race, where the boys are called upon to sit perfectly still, a dance on deck being found very detrimental to the speed of the vessel. In avoiding the troubles incidental to but inseparable from the crank engine, and giving a practical illustration of the locomotive with rotary engine, the projectors of this road have perhaps made an advance in railroading.

In Figs. 1 and 2 the artist has shown the engine-driver with his right hand upon his throttle and reversing valve lever, and his left upon the stem of his globe valve, and from the simplicity and light weight of all these parts he has probably more perfect control over his engine than was ever before attained upon a locomotive.

PASSENGER CARS.

The passenger car, of which Fig. 3 is a side view, is one half in section, showing interior and construction, is



carried on bearing-wheels F F, and steadied by guide-wheels G G in precisely the same manner as the locomotive. The frame of the car is composed of iron ribs, which extend over the top, and following the contour of the sides as at H, connect across the floor and follow down to the guide-wheels G, from there extending outwards, supporting the side platform. To these ribs are screwed wooden furrings of similar outline, and to these again are secured the light planking which gives great strength to the car longitudinally, and the whole combination gives strength and space for carrying sixty passengers, with a total weight of the car of only 9000 lbs. The seats are arranged in two tiers, the upper one having seats like an omnibus or common horse-car, at the sides and facing each other, the floor between being just above the bearing-rail A, while the lower tier on each side faces outward like the Irish jaunting-jar, and by the contour of the side is brought partly under the upper tier, reducing the width to 9½ feet, or with the side platforms, 12 feet 4 inches, the length over all being only 25 feet. A peculiar feature of the upper part of this car is the raised step under the seat, giving relief to different lengths of limb, and being a great relief to the ladies in enabling them to keep above and out of the main spitting level of the inevitable boor.

In freight cars the advantage of carrying a large portion of the weight below the level of the bearing-rail, especially on sharp curves, is obvious, and more than counterbalances any additional trouble occasioned by the division of the car.

LONG ROADS.

The road, as shown here, is designed for city and rapid transit, where the height above the ground, as well as the length of the span between supports, is necessarily great; but for country roads a much simpler and more economical style of construction is recommended, wherein the roadway consists of a single bearing-rail A of iron, the side-rails B B being of hard wood, and the side-plates that support B B are brought together near enough to bolt directly to the posts, which should be of cedar. A road of this kind, capable of carrying a load of four tons per bearing-wheel, is estimated upon as follows. For each mile in length:

Steel bearing-rail, 40 lbs. per yard, at $65 per ton..	$1,242 00
Splice-plates and spikes........................	135 00
Stringpiece 8 x 10, side-plates 5 x 6, side-rails 3 x 4, all of hard or Georgia pine..............	1,700 00
Lag bolts, plate bolts, and spikes................	160 00
Cedar posts, 8 inches in diameter, 12 feet long, 550 per mile at $1............................	550 00
Setting in concrete base, 25 cents per foot..........	137 50
Mill work, squaring ends and boring bolt holes....	250 00
Contingencies..................................	325 50
Total......................	$4,500 00

The above figures are obtained with reference to the south-eastern part of New-Jersey, where the soil is sandy; but it is to be remembered that in no case is any amount of grading or earth work to be allowed for, no culverts to provide: the only difference required by small streams is a slight increase in length of posts perhaps (and this is the better rule for crossing all highways and railroads), also an increase of elevation and span, requiring only a little more lumber at such points to reinforce the stringer plates and posts, and no other extra expense; swamps or peat-bogs may require some crib work, but again it is only a call for more cedar, and nothing else. Such a roadway should only need renewal in from fifteen to twenty years. The bridging of highways and streams adds little or nothing to the first cost. The single bearing-rail is about five feet from the ground as a minimum.

A. V.

THE INTERNATIONAL CARRIAGE EXHIBITION.

(Continued from page 465.)

FOREIGN CARRIAGES.

CARRIAGES and other vehicles are exhibited by foreign countries in considerable number and great variety of style, occupying the southeastern section of the building. The chief exhibitors are England and Canada; Russia, Austria, and Italy are also represented. The exhibits from England are particularly worthy of notice, some of the best known of the London firms and leading manufacturers in Manchester and Norwich being represented. *Messrs. Peters & Son*, of London, make a very striking exhibit, and one which, from its conspicuous position near the main southern entrance, as well as from the novel appearance to Americans of some of the objects displayed, always attracts curious attention. The distinguishing feature of this exhibit consists of two pleasure or pic-nic drags, such as English gentlemen use for coaching, going to races, hunting parties etc. They are both large and handsomely finished, and both have running gears of red, striped with black. The bodies are oval shaped, and in one the lower panels are of blue, and in the other of maroon, in each instance the striping with which the darker tints are relieved being carmine. The lining of both is rich blue leather and cloth. On top are boxes and hampers for carrying luncheon, with a wicker-holder for a horn, and in front is a silver-mounted lantern. The drag resembles very much the American hotel coach, except that it has seats on top as well as inside, and is much more elegantly finished. It is driven with four-in-hand.

The next exhibit is a handsome coupé, with the body and running gear colored in rich green and black, with inside trimming of rich green leather and cloth; and adjoining this is a coach with a body of very dark maroon and black, with vermilion striping and blue trimmings. The other exhibits are a handsome road wagon, with body and running gear of black, relieved with rich stripings of blue and blue lining; a phaeton, in similar finish; a coupé, in dark brown and black, with striping of light brown; a dog-cart, and a no-top phaeton, very prettily finished in very dark green, with running gear of black, relieved with red.

Hooper & Co., of London, also make an interesting exhibit. We have, first, a drag, of the size, pattern and construction approved by members of the London Four-in-Hand Club, and strongly but lightly built. It is fitted with lunch and pic-nic arrangements, and is so put together that the various portions of the carriage and fittings form tables to enable the occupants to partake of lunch without spreading it upon the ground. The roof is fitted with a sunshade and a folding ladder carried in the hind boot, to enable ladies to mount to the outside seats. This ladder is provided with white treads, showing where to place the feet on dark nights. The next exhibit is a park barouche with C springs, after the pattern of that used by the Princess of Wales. The color is black, with a glaze of rich carmine varnish, throwing a warm tint over the ground color, and relieved by gilding with a thread of crimson. A Sefton landau is exhibited, with a patent catch to fasten the head, which enables a lady to close or shut the carriage either from the inside or outside; making of it either a close or open carriage. The lower panels of the body are dark blue, with body and running gear striped with yellow. Near by is a miniature brougham for a small horse; next to which is a park phaeton for two horses, with body of dark brown, striped with vermilion, running gear of carmine and black, and lining of blue silk. The last of the exhibit of Hooper & Co. is a Vienna phaeton of recent introduction into England, and partaking somewhat of the appearance of the German and Russian droskies, with some improvements. It is hung on high wheels, with wings to keep off the mud; but the body is hung low.

In addition to their exhibits of carriages this firm sends a number of drawings of London fashions for carriages; pictures of mail and stage coaches, drags, phaetons and tandems, with horses, drivers, etc., illustrating incidents "on the road;" outline drawings of carriages in pencil, by G. N. Hooper, and horses by B. Herring; an engraving and photograph of the royal stage coach; views of the firm's manufactories and royal warrants of appointments as coach builders to William IV., Queen Adelaide and Prince Albert; pencil sketch of a German sledge, with suggested alterations in pencil made on the drawing by Prince Albert, and a variety of pictures of different carriages manufactured by the firm for members of the royal family, etc.

C. Thorn, of Norwich, England, sends eight vehicles—a char-a-banc, a landau, a brougham, a phaeton, a Victoria phaeton, a Stanhope phaeton and wagonette, a shooting cart and a gig. The char-a-banc is of French origin, and was but recently introduced into England. It has accommodations for twelve persons, and is painted black and red, with the under-carriage and wheels red, relieved with black. Overhead is a light canopy with curtains to shield the occupants from rain or sun. It has bars and fittings for four horses, lamps, and brakes working both before and behind the back wheels. The landau is a handsome carriage, somewhat angular in shape, the head being fitted with a self-acting catch, so that it may be opened or closed from the inside by the occupants. This carriage is painted rich blue, relieved with yellow, and is lined with morocco. The phaeton is a light pony carriage in the Parisian style. The body is painted dark green, with a relief of primrose, while the running gear is painted primrose, with lines of green. The cushions are of green morocco. An awning, removable at pleasure, protects the occupant from the weather. This brougham is circular fronted, and is painted in a rich-toned brown, relieved with a single fine line of yellow. The lining is of brown morocco. The Stanhope phaeton and wagonette is painted green, relieved with white, and is lined with green to match. By means of compressed spiral springs one half of the front seat may be made to rise, so that a lady can pass from the hind to the front seat without trouble. The hind door is also made to open or close by the driver without leaving his seat. The Victoria phaeton has self-acting apparatus for closing the head, which can be raised again without stopping the horses. The body of the carriage is painted a deep blue, relieved with a fine line of French gray, and the running gear is painted French gray, relieved with blue and fine lines of black, thus giving a very light and stylish effect. The shooting cart is fitted with the usual sporting appliances, and is neatly finished. The gig is painted a rich claret, relieved with red and lined with blue.

John Roberts, of Manchester, England, exhibits a very pretty open phaeton, with dark blue cushions and body relieved with red striping. *H. Mulliner*, of Leamington, exhibits a hunting cart, a coupé and a handsome landau, all very tastefully painted and finished. A double-seated brougham, a landau, a Victoria-Parisian and a Stanhope phaeton, are exhibited by *C. S. Windover*, of London. In the brougham a reading lamp is affixed behind the back light, by which the interior of the carriage is illuminated. The brougham is painted a rich green, with fine lines of gold, and is lined with silk tabbaret and laces to match the body. In the landau the front light is self-acting with the head, and opens and closes with it. The carriage is painted in lake, relieved with vermilion deeply glazed. The Victoria-Parisian will carry four, six or seven passengers, and is fitted with sun shades and lunch basket. The Stanhope phaeton, or T cart, is a very pretty carriage for gentlemen, painted dark green, picked out with fine lined light green. *Messrs. McNaught & Smith*, of London, exhibit four carriages, noticeable both for neatness in finish and tasteful coloring. They comprise a brougham, in black, relieved with chocolate, with running gear of chocolate, black and yellow, and lining of fawn-colored brocade; a barouche, in chocolate and orange; a landau with patent balance head in dark green, with running gear of green, relieved with lines of lighter green and trimming of rich green morocco, and a brougham in dark blue, with lining of pearl gray. A feature in the construction of this carriage is an edging of vulcanite on the cloth window sashes, which prevents it from wearing out. C and under-springs are used in all the carriages, and the tires of wheels and forgings are all of Whitworth metal.

The Italian manufacturers are represented by exhibits from one maker only, *Alessandro Locati*, of Turin, who sends two curious-looking specimens of the Italian cab, somewhat resembling the English hansoms, except that the passenger gets in from behind instead of in front. One of them is painted in white and blue, with silver mountings, and lamps of blue glass on either side. The lining is of blue silk. The seat for the driver is in the rear of the body above the door. The other cab is similar in general form to the first, except that a section is cut off the front portion of the body, making the front slanting instead of upright, and giving the body a very odd appearance. The exterior coloring is of black, with stripes of red and fine lines of silver plate. The lining is of orange-colored leather. The running gear of both carriages is heavy and substantial looking.

Austria is represented by the exhibit of *S. Armbruster*, of Vienna, who sends a heavy coach, painted in chocolate and black, with running gear of black striped with brown. The lining is of brown satin. This manufacturer also exhibits a gentleman's handsome phaeton. The body is of varnished walnut and maple, with lining of blue cloth and chocolate leather, neatly finished.

From Russia one exhibit is sent—that of *Joseph Vernik*, of Warsaw, Poland. *Mr. Vernik* exhibits a very pretty road wagon, with heavy running gear of black with light brown stripes, with a seat behind for servant, and a barouche, with dark purple lining, and painted in black with white stripes. In this carriage is also exhibited a costly lap-robe of bear-skin. A curious feature of this exhibit is a light Russian trotting wagon, whose purpose would scarcely suggest itself to the majority of visitors. The running gear is very light, and is hung on four small wheels. On it rests a long piece of board covered with blue plush. This board serves for the seat of the driver. A greater contrast than that afforded by this wagon as compared with the ordinary trotting sulky used in this country could scarcely be imagined. The last of these exhibits is a Russian sleigh, hung very low on light runners, and lined with dark blue cloth. There are seats for two persons, and a tall box in front, in which the driver stands up.

Canada is well represented by a very large exhibit, embracing a number of specimens of superior workmanship. *B. Ledoux*, of Montreal, sends a heavy family coach and a very large sleigh, capable of accommodating comfortably six people, with a rumble seat for servant. The body is of the phaeton shape, and is colored in a very pretty maroon and dark brown, with lining of brocaded brown silk. The seats are placed in tiers, the front one being highest, and the rest gradually descending until the last in the rear is reached-

The body is hung on a double set of runners—that is, a pair in front and a pair behind. This construction permits of much greater ease in turning.

Daniel Coabog, of Uxbridge, Ontario, sends a very pretty cutter, with two seats and lining of dark green edged with beaver-skin. The body is colored in maroon and ebony, with gold and silver mountings. On the side is a casting of the maple leaf in silver, and on the dasher the figure of the beaver in gold. The beaver and maple leaf are the national emblems of Canada. The seats are so arranged that they may be turned into two seats or one, as might be desired.

John M. De Wolf, of Halifax, N. S., exhibits a buggy, two phaetons, and a handsome drag. *Wm. Kew & Sons*, of Beamsville, Ontario, send a sleigh with a phaeton body, richly finished in dark green, with fine lines of gold. *J. B. Lejare*, of Quebec, exhibits a specimen of the ordinary wooden sleigh used in Canada, and *Woods Lyons*, of Brantford, Ont., sends a Canadian cutter in plain black, and a buggy, and two phaetons. *Knox & Rothewill*, of Goderich, Ont., send two light side-bar buggies.

From Australia there is one exhibit. *John Robertson*, of Sydney, New South Wales, sends a road wagon, with body of unpainted woods, varnished. On one side is painted a kangaroo, and on the other a picture of the ostrich.

CARRIAGE WOOD-WORK.

In the southwestern section of the building there is a very complete exhibit of carriage wood-work. It consists chiefly of carriage wheels of various sizes, patterns, and weight, patented contrivances for strengthening wheels, and unpainted carriage bodies. Manufacturers are represented from the following places: Philadelphia; Wilmington, Del.; Lancaster, Pa.; Stockton, N. J.; Sandusky, Ohio; Mechanicsburg, Pa.; New York; Charlestown, W. Va.; Darlington, Wis.; Newark, N. J.; Portoria, Ohio; Greencastle, Ind.; Elizabeth, N. J.; Toughkenamon, Chester Co., Pa.; Fort Wayne, Ind.; West Chester, Pa.; Dayton, Ohio; New Haven, Conn.; and Logansport, Ind.

IRON AND OTHER METAL WORK.

The exhibit of iron work for carriages, wagons, etc., embraces specimens of the numerous articles, large and small, used in carriage construction. These include axles, bolts, screws, steps, bows, whip-sockets, curtain lights, curtain-fasteners, buckles, rings, metal-loops, mountings in gold, silver, and nickel, carriage springs, etc. These exhibits are all arranged in handsome cases, and embrace specimens from different manufacturers throughout the country. In addition to the exhibits of American manufacturers, there is an exhibit of axles, springs, etc., from *Dick & Kirtscher*, of Offenbach-on-the-Main, Germany.

Besides this class of exhibits, iron-workers are represented by several exhibits of ornamental iron railings, and by a very pretty display of garden statuary in iron, wire-work, etc., made by E. Darby & Son, of Philadelphia. The exhibit is enclosed by an iron railing, and comprises chairs, sofas, bird cages, etc., of wire; the statue of an Indian in iron, painted to represent green and yellow bronze, leading a wolf; two female figures in iron, painted in imitation of marble, and a very pretty fountain. The pedestal of this fountain is square, and is painted in green and brown. From it rises a vase, green bronzed, with gracefully-executed storks at the sides, and small bronze flower-pots, in which are creeping vines that clamber over iron supports upholding another vase filled with delicate floats. The whole is very tastefully conceived.

There is also a vase colored in brown and black—a light-brown field, with which are effectively contrasted black leaves and vines, together with storks and swans also in ebony. The jets are of iron, moulded and colored in imitation of callas.

R. Lynez, of Philadelphia, exhibits wire railing and skeletons in wire for floral designs, together with a great variety of colored grasses in a variety of pretty tints.

CHILDREN'S CARRIAGES.

The exhibit of children's carriages, although not so large as some of the other exhibits, nor covering nearly so wide a range of manufacturers, is highly attractive. On some of the carriages a great deal of elaborate ornamentation has been expended, and many of them are finished with the greatest care, and with pleasing contrast and coloring and trimming.

In the Foreign Section, *Charles Thompson*, of London, exhibits a very pretty carriage, painted blue, with striping of white, and lined with blue cloth. The "pasher" is of silver plate and ivory, and the carriage is shaded by a canopy of blue silk, with rich fringe. The American exhibit of perambulators occupies space in the western portion of the building north of the carriage exhibit, and embraces a great variety of patterns. In addition to the perambulators, there are rocking-horses, a baby's walking-chair, velocipedes, a swing, and a cradle, which is rocked by means of spiral springs.

BICYCLES.

Messrs. Haynes & Jefferis, of Coventry, England, exhibit in the southeastern corner of the building, near the foreign carriages, a large collection of English bicycles, or two-wheeled velocipedes. Some of them are very large, and others comparatively small, while all are constructed in the lightest manner consistent with strength. Riding on bicycles has recently become very popular in England, and *Messrs. Haynes & Jefferis'* exhibit comprises all the different patterns and sizes used by the English bicycle clubs.

STEAM-RAILWAY CARS.

The exhibit of steam-railway cars occupies a portion of the northwestern section of the building, and comprises specimens of the work of several of the best-known car manufacturers in the country. There are no exhibits of railway car construction from foreign countries. First in order, beginning on the northern side, is the exhibit of the *Harlan and Hollingsworth Company*, of Wilmington, Del. This comprises two cars—one a broad and the other a narrow gauge car. The broad gauge is a parlor car, very handsomely finished. The body is colored on the outside in rich maroon, relieved with broad bands of green, and with striping of gold, light green, and black.

The interior finish consists of panels and trimmings of walnut, butternut, ash, and cherry, with rich gilding. The wood-work is unstained, showing the natural grain, polished. The roof and the space below the ventilators is richly frescoed in a variety of tints. In the front of the car is a smoking-room, and in the rear of this is a wash-room, closet, etc., with various conveniences. The floor is covered with a handsome carpet, and the chairs are trimmed with crimson velvet plush. The latter are so arranged that they will turn all the way round without touching each other. The car is also provided with six plate-glass mirrors, with frames of walnut and butternut, richly gilded. The shutters are of cherry, and are so arranged that when raised they will clear the window entirely, giving a larger space to look through than is generally obtained in car-windows.

In the rear of this car is the narrow-gauge car. The exterior coloring is dark brown and yellow. Inside, the panelling and trimming is of plain ash and walnut, butternut, cherry, bird's-eye maple, and mahogany. The mouldings are of gilt. The seats are lined with crimson, and the back with green plush. The general finish of the car is rich and pleasing, while not particularly elaborate. Both cars are furnished with the Hodge brake.

The *Wason Manufacturing Company*, of Springfield, Mass., sends a coach, showing the ordinary work of the company, and built for the Central Railroad of New Jersey. No attempt has been made at elaborate ornamentation, and the car is exhibited merely as a sample of the average workmanship of the company.

The *Jackson & Sharpe Company*, of Wilmington, Del., exhibit two cars—one a narrow and the other a broad gauge. The narrow-gauge is a boudoir and parlor car, called Dom Pedro II., built for the Sao Paulo e Rio de Janeiro Railway of Brazil, and to be used on State occasions. It is constructed in sections, so that it may be taken apart and stowed in the hold of a vessel, and is furnished with Miller platforms and the Westinghouse brake. It will seat thirty persons. In the front portion of the car is a small boudoir. This is fitted up with seats of drab morocco, with heavy, magenta colored fringe, forming a very pretty contrast. The carpet is of drab, covered with delicate flowers, and the window curtains are of dark green and gold. Near the centre is a table covered with crimson rep, on which are placed pictures of the Emperor of Brazil and his daughter, the Princess Imperial. There are also two handsome mirrors and two cabinets—one containing books, and the other preserved meats and fruits for luncheon—on which are placed gold-plated candelabras holding wax candles. The sides are inlaid with different woods, and the car is lighted from the top by small windows of stained glass. Adjoining the boudoir are two very pretty rooms—one a reading and the other a writing room; one fitted up in blue, and the other in crimson. Next to these is the ordinary compartment, with walnut chairs cane-seated, and the sides beautifully inlaid in gold, walnut, mahogany, and ebony. The doors have panels of French walnut and rosewood.

The other car exhibited by this company is fitted up as a parlor car, but is not furnished with chairs, having the ordinary passenger car double seats. It may be used, however, either as a parlor car (by removing the present seats and substituting others), or as an ordinary passenger car. It is fitted up with the usual conveniences of wash-rooms, closet, heater, etc., and is handsomely furnished, the inlaid wood work being similar to that in the Brazilian car already described.

The *Pullman Car Company* exhibits two very handsome cars, one a parlor car and the other a hotel and sleeping car. The first contains a smoking room and general compartment for passengers. The smoking room has furniture of dark maroon and the wood-work is of walnut, with French walnut veneer. The ceiling is frescoed in light tints. In the compartment the chairs are covered with light brown silk plush, and the backs may be let down so as to turn them into easy-chairs. The wood-work is richly inlaid with American and French walnut, mahogany, holly, gold, and rosewood. Above the windows are heavy mouldings of rosewood richly carved. A feature of the inlaid work is bouquets of flowers, made of pieces of wood stained in different colors and then inlaid, producing delicate and beautiful effects. The ceiling is lined with canvas, on which are painted in pale tints wreaths of flowers. On the panels between the windows is the monogram "P. P. C. C." for the title of the company, painted in blue, gold and red, on a ground of pale green. At one end of the car is a large mirror with frescoes on either side, of two child-figures, with tall plants and richly-colored flowers rising in the background. The windows are very wide and have screens of wire to keep out dust and cinders. The hotel and sleeping car is fitted up with all the usual appliances of cars of this pattern, and is very expensively decorated. In the fore part of the car is the kitchen, which contains a large Chicago range and all the necessary utensils. Near this are the china and silver closet, wine cabinet, linen closet, etc. The dining and sleeping room are combined in one. The berths are so arranged that they may be closed up in the day-time and placed entirely out of sight, with the exception of a portion of the frame which is shut up against the side of the car. This frame is utilized for decorative purposes, however, appearing to be nothing more than a large square panel of the side of the car, placed in a slanting position and richly carved. When let down for the night the berths are transformed into comfortable beds, in two tiers, having rich hangings of crimson, with broad bands of blue and gold. When transformed into a dining room the compartment is broken up into little sections, with a table and seats for four in each section. The car is also fitted up with toilet rooms, heater, and a number of handsome mirrors. The refrigerator is a square box hung underneath the car. The brakes are the Westinghouse patent, and on each side of the wheels is a large flange, which, should the car run off the track, will catch on the rail and prevent it from going further.

STREET RAILWAY CARS.

Several specimens of street railway cars are exhibited in the northwest corner of the building. The first of these is a car built by *J. G. Brill & Co.*, of Philadelphia, for the Beacon-street railway of Boston. The exterior is colored in light tints, and the interior is elaborately finished. The woodwork is chiefly walnut, beautifully inlaid with tulip root, amboine, ebony and holly. As in the Pullman car, a feature of the interior decoration is the inlaid work in flowers, scrolls, and other designs in different colored woods in natural colors, and woods which have been stained before the inlaying. The cushions are covered with blue plush, and the shutters are of walnut and linn wood. There are new patent ventilators running lengthwise of the car, and the roof is lined with amboine and walnut, gilded, and inlaid in pretty designs. The whole of the interior finish of the car is very elaborate and handsome. The special merits claimed in construction are the introduction of Higley's running gear, which is said to reduce the friction sixty per cent; rubber springs which make the car run much more easily; a patent attachment for putting on a new brake-shoe, and an arrangement for lowering or raising the pole to suit the varying sizes of horses.

J. M. Jones & Co., of West Troy, N. Y., send a car built for the Highland-street railway of Boston. The noticeable feature about this car is that the exterior coloring consists mainly of an imitation of one of the Highland plaids, laid on in a broad band extending around the body of the car. This was done in deference to the fact that the car was in a district known in Boston as "The Highlands." Inside the car is finished in different woods in a neat and tasteful manner, and the seats are trimmed with moquette, covered with flower work.

John Stephenson & Co., of New-York, exhibit two cars. One was built for the Central Cross-Town railway, of New-York, and is colored outside in blue, yellow and reddish tints, while the inside is finished in plain varnished woods, with metal-covered seats. The other car was built for the West End Passenger Railway, of Philadelphia, and in its construction more attempt at decoration is made. The wood work inside, although plain, is very neatly finished, and is in effective contrast with the Magenta-colored trimmings of the seats. This car is also provided with rubber springs, and the coloring of the exterior is of light yellow and white very tastefully blended.

HEATING AND COOKING APPARATUS.

The exhibits of stoves, ranges, and other apparatus for heating and cooking is large and varied, occupying the greater portion of the northeastern section of the building. The manufacturers of Philadelphia, New-York, Cincinnati, Baltimore, Pittsburg, Chicago, and other localities are all well represented, and new patterns and recent improvements are exhibited in almost inconceivable variety. There are no foreign exhibitors. It would be practically impossible to give the points of difference between the exhibits, from the fact that they are so multiform and varied. In the objects sought to be attained, many of them differ greatly. Some are evidently designed with a view to ornamentation; others with a view chiefly to durability. Economy of fuel is the leading object of many, while a number of cooking stoves are exhibited, the chief merit of which is claimed to be concentration of heat in the oven, from which follows superiority for baking purposes. The display of heating apparatus for heating houses by means of hot air is also very complete, and in this connection there is a very full exhibit of registers, Steam heating and ventilating apparatus also forms a prominent feature of the exhibit.

HOUSE-FURNISHING GOODS.

The display under this head is not arranged in logical order, but is composed of a mass of heterogeneous articles, grouped together north of the stove exhibit. A great variety of appliances for economizing time and labor in the management of a household are shown. The exhibit is, therefore, of particular interest to housekeepers. The display of refrigerators, although not large, embraces several improved patterns, each of which has special advantages of its own, and the exhibit of washing and clothes wringing machines is large and well worth attention. The other housekeeping articles exhibited include a patent ironing table, earth closets, patent roasters for roasting chestnuts, peanuts, pop-corn, etc.; disinfecting apparatus, standard quart measure, self-acting soldering irons, patent nursery cups, hand-racks, stove-pipe, clothes dryers, standard iron measures, safety kerosene lamps, corn graters, sifter, callender and strainer combined, portable shower-baths, patent oil-cans, soapstone fire-places, sinks, griddles, etc.; toilet ware in tin, manilla water-pails, foot baths, etc.; extension ladders for house cleaning and store purposes, water filters, water coolers, cookers for cooking with steam, patent brooms, portable washstands, bath tubs, plumbers' work, patent back and head support for bath tub, wooden ware of different descriptions, such as churns, tubs, washboards, etc.; patent fruit jars and nursery bottles, tin churns, copper ware, tea trays, toasters, dust pans, tinware in great variety, smoothing irons, dredge boxes, kettles, etc.

IRON SHUTTERS.

Messrs. Clark & Co., of New-York, have erected a pavilion in the western portion of the building, in which to show the operations of their self-coiling shutters, for stores, offices, etc. The shutters are made of narrow bars of iron, steel, or wood, laid horizontally, with elastic bands of steel passing through them and holding them together. When the shutter is pushed up, the steel bands, being easily bent, coil themselves and the bars up in a hollow iron cap at the top of the window or in a projecting cornice, and, when pulled down, they uncoil, and form an unbroken front.

CAR COUPLERS.

Near this exhibit is a model of a train of cars, exhibited by *H. G. Russell*, of Lincoln, Ill., for the purpose of illustrating the workings of a new invention, by himself, for coupling cars. The coupling is done with this arrangement without the necessity, on the part of the brakesman, of getting between the cars. The coupling apparatus consists of heavy steel draw-bars, with hooks, which, when the cars come together, catch in a square hole cut into an iron "bull's nose" on the end of each of the cars. If it is so desired, by means of a very simple arrangement the apparatus can be thrown out of gear, and consequently, the cars, when they come together, will not couple. No springs are used and the mechanism is at once simple and ingenious.

The *World Champion Car Coupling Company*, of Tiffin, O., also exhibit an automatic car coupler, which is operated with a spring; and *Stephen Ustick*, of Philadelphia, exhibits both car couplings and patent lubricators for oiling the running gear of cars. *R. L. Williams*, of Middle Granville, Washington County, N. Y., also exhibits an arrangement for coupling cars; and *John A. Haase*, of Philadelphia, sends a model of a swinging step to be attached to the ends of cars, and to be used by brakemen, as also the model of a wooden truck to be placed over hose so that street railway cars may be enabled to pass over the hose without hurting it. The track is made in sections, which can be quickly fastened together. It consists of a line of rail, with a gradual ascent and descent, with holes running horizontally through the highest part, through which the hose is passed. This leaves the hose beneath the rails, and the car is enabled to pass over it without difficulty.

ELEVATED RAILWAY.

Richard P. Morgan, Jr., exhibits the model of the Gothic Arch Elevated Railway prepared by order of the Rapid Transit Commissioners of New-York City. It consists of two lines of rail laid on cross-ties, which are supported by strong gothic arches at frequent intervals. On each side of the two tracks is a railing, and in the centre is a high line of truss work.

MISCELLANEOUS.

The *Pennsylvania Working Home for Blind Men* makes a very creditable exhibit of brooms, brushes, carpets, mattresses, harness, cane chairs and door mats made by the inmates.

A. Wilt & Son make a display of walnut, pine, and poplar doors. *J. E. Patterson & Co.*, of Pittsburg, Pa., fill a considerable space with some very handsome specimens of carpenter's work in doors and newel posts for stairways. The work is chiefly of pine, thickly veneered with ash and walnut, richly carved.

In addition to the exhibits which have been mentioned, there is a great variety of other unclassified objects, such as specimens of sheet-iron roofing, model of an express wagon, model of an improved jump seat, patent iron tiles, improved window supports designed to take the place of the cord and weights, skylights, corrugated iron shutters for vaults, refrigerators of zinc, roofing of tarred paper covered with sand, movable partitions, model of stair railing, model of an improved sled, conductor's punches, chairs, baskets, screws, etc., of wicker work; baskets of wood for woollen, carpet, cotton and hosiery mills; baskets, machine belting and trunks made of paper; lamp shades, boxes for holding silver or knives, a model wooden house, metallic roofing, car lamps, racks for railway cars, house and car ventilating apparatus in great variety; wooden backs for blacking brushes, scrubbing brushes, etc.; spiral and other springs for holding up windows, rubber steps for carriages, cars, etc., with roughened surfaces to prevent slipping, and match splints.

On each side of the north entrance is a colossal eagle, in iron, gilded, exhibited by *Hough & Co.*, architectural iron workers, of Indianapolis. Near this, in a small case, is a set of harness, handsomely stitched and mounted, which is exhibited by *James R. Hill & Co.*, of Concord, N. H; and a little to the right of the entrance is a curious exhibit of tinware. The tin is worked into very fantastic forms—such as fans, drums, children's carriages, hats, hair brushes, combs, knives, forks, shoes, gloves, guitar and a full-rigged schooner. The only material used in the construction of these articles is tin; and their appearance is very odd. In addition to these, there are horns, food-heaters, egg-boilers, pots, pans, cuspidors, and other useful articles. The exhibit is made by *Musgrove & Son*, of New-York. A patent clock and starter and a collection of badges and emblems are exhibited.

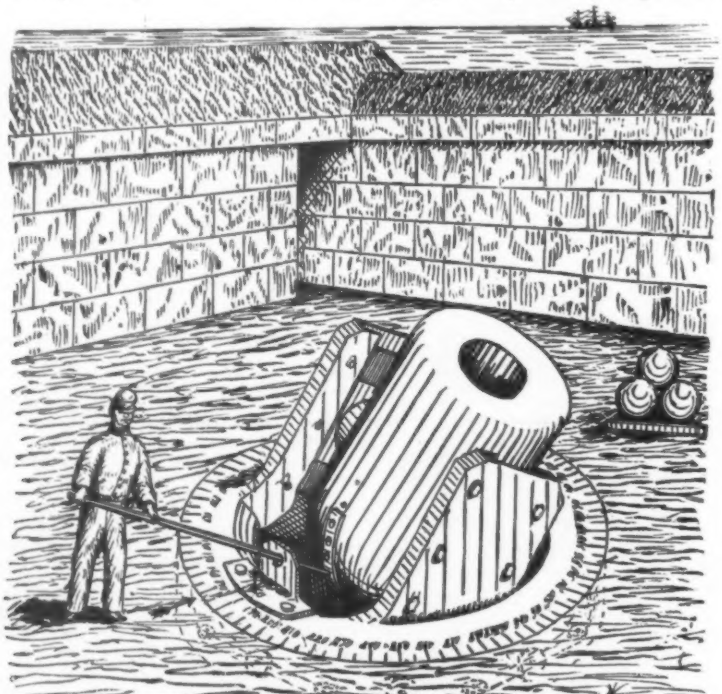
Taken altogether, the exhibit in the carriage building is one of the most varied and not the least interesting of any of the exhibitions within the enclosure. It epitomizes at least three of the leading manufacturing interests of the country—carriages, stoves, and house-furnishing goods—and illustrates, in addition to these, the immense strides which have been made in America in cheapening and making pleasurable travel not only by steam, but also by horse power through the streets of our cities. As thoroughly illustrative of these important branches of industry, it takes rank as being of real practical worth; and to those in search merely of the curious or the decorative, it is also not uninteresting.

THE CENTENNIAL EXHIBITION.

NOVEL MORTAR CARRIAGE AND TRUCK.

The accompanying sketch shows the method of mounting mortars of large size, in sea-coast batteries (as represented here by model), invented by Captain W. R. King, of the Engineer Corps, U. S. A.

As will be seen from the cut, the mortar is hung so as to be free to swing in a vertical plane to obtain the proper elevation, the bearings being carried by a circular carriage, which travels around a vertical axis and rests upon eight large trucks, shown by the dotted lines, and guided in its bed by eight more trucks, placed alternately to the others, and in position to bear upon the inside of the stationary bed; the result being that one handspike is sufficient to both elevate and train the piece—a saving of the labor of six or eight men, required by the ordinary chassis, with a centre pintle, now used. Another peculiarity of this invention is in the method of taking the recoil upon springs, of india-rubber or steel, placed in the cheeks of the carriage, and carrying the beds in which the trunnions turn, these beds being made free to slide in the cheeks; and the only effect of the recoil is to drive the piece downward into the pit of the stationary bed, the springs meeting the shock and returning the piece to its proper level ready to reload. The proper aim, or direction, is obtained by means of an arrow-point cut in the stationary bed compared with a graduated circle upon the carriage proper, while the elevation is got, as in common mortars, by laying a quadrant across the muzzle of the piece. The muzzle being, of course, at right angles to the centre of the bore, the difference between a straight edge, laid across it in the plane of elevation, and a plumb-line is just equal to the difference between the centre line of the bore and a water level.

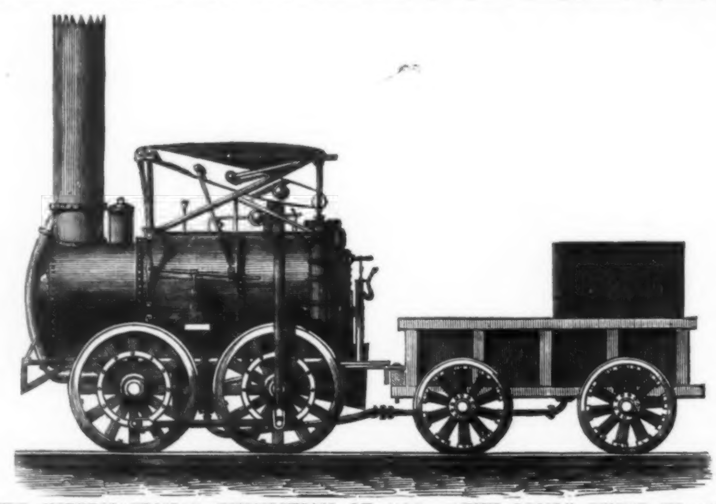


THE INTERNATIONAL EXHIBITION OF 1876.—MORTAR CARRIAGE.

Figure 2 shows the truck, and manner of grasping and lifting the shell. The truck is made with a strong pair of wheels and axle, surmounted by a tongue, to the lower end of which are secured a pair of cheeks projecting outward, and curved something in the shape of a pitchfork. A pair of hooks with a lanyard grasp the shell by two small holes, the truck is backed up and the lanyard made fast, as shown in the cut, when by depressing the tongue the shell is easily lifted, and being retained in position by the hooks and lanyard, is brought to the muzzle of the piece; and the lanyard being slacked and hooks removed, it is free to pass into the bore. This is also the invention of Captain W. R. King, of the Engineer Corps. A. V.

A RAILROAD RELIC—THE LOCOMOTIVE "LION."

Among the mechanical curiosities exhibited at Philadelphia are a walking beam, wheel centres, and a few other details, all that remain of the old locomotive "Lion," which



THE INTERNATIONAL EXHIBITION OF 1876.—"THE LION," BUILT IN 1829.

ran for the first time upon the Delaware and Hudson Canal Company's railway on the 12th of June, 1829. This railway was the third built in America, the first having been constructed near Quincy, Mass. This was three miles in length, and was commenced in 1827. The gauge of this road was 5 ft., and the rails consisted of pine 12 in. deep, covered with oak planks, and protected by flat iron bars. The rails were laid upon granite sleepers, 7 ft. 6 in. long, and placed 8 ft. apart. The second railroad was commenced later in 1827, and extended from the Mauch Chunk coal mines to the Lehigh River, nine miles distant. This was a gravity worked line, the empty cars having been hauled up by mules.

On the 4th of July, 1828, the works of the Delaware and Hudson Canal Company's railroad were commenced, and Mr. E. L. Miller, of Charlestown, and Mr Horatio Allen were sent to Europe to study what was being done at that time in England. During their stay, Mr. John B. Jervis, then chief engineer of the Delaware and Hudson Company, sent over orders to procure rails and three locomotives for the new work.

These instructions were duly carried out, and the "Lion" was the first of the three engines shipped to New York, where it arrived about the middle of May, 1829. The accompanying illustration shows the arrangement of the engine. It had four coupled wheels driven by two vertical cylinders, with 36 in. stroke, placed at the back, on each side of the boiler. The motion of the piston was transferred through two grasshopper beams to the connecting rods and crank pins in the wheels. The length of the boiler, which was cylindrical, was 16 ft. 6 in., including the furnace and smokebox. The machine was built by Messrs. Foster, Rastrick & Co., of Stourbridge. After some time the engine was abandoned on account of the imperfections in the road, and it was finally taken to pieces and the different parts utilized. The boiler was worked for many years afterwards.—*Engineering.*

CARRIAGE EXHIBITS AT THE CENTENNIAL.

The accompanying engravings and description we condense from *The Hub*:

No. 36. *Drawing-Room Coach.*—This carriage can be thrown open at the sides, as our illustration shows, by sliding the quarter-lights, together with the light standing pillars into the quarters, while the windows in the doors may be secured by Wood's patent window-flaps, or dropped into the doors. Dimensions: Width of body over all, 51 in.; turn-under, 3⅝ in.; wheels, 3 ft. 5 x 4 ft. 1 in.; hubs, 5¼ x 8 in.; spokes, 1⅛ in.; rims, 1⅛ in.; tires, 1⅜ x ¼ in.; axles, 1⅜ in.; springs, 5 plates, 1¾ in. wide.

No. 37. *Vis-à-Vis Phaeton.*—Dimensions: Width of seat frames, 41 in.; width of body on top of seat panels, 46½ in.; dickey-seat frame, 25 in. wide; rumble, 16 in. wide; wheels, 3 ft. x 3 ft. 8 in.; hubs, 4⅝ x 7½ in.; spokes, 10 and 12, 1⅛ in.; rims, 1⅛ x 1⅜ in.; springs, front, 4 plates, 1¼ in. wide, 38 in. long, 11 in. high over all; hind, 5 plates, 1½ in. wide, 38 in. long, 12 in. high; C springs, 4 plates, 1½ in wide; axles, front, 1¼ in.; back, 1⅜ in.; track, front, 4 ft. 2 in.; hind, 4 ft. 10 in.

No. 38. *Canoe-shape Five-glass Landau.*—This carriage has an iron perch and deep crank-axle, which allows it to be hung very low, or about 27 in. from the ground. The top quarter joints are curved at both ends. The elliptic springs are of the straight pattern, with French heads. Fifth wheel, full circle, 24 in. diameter, with straight beds, and stiff, straight draw-bar, curved in centre under the futchels. A speaking-tube and a bell afford means of communication with the driver. Dimensions: Back and front quarters, 42 in. outside; at each door-pillar, 52 in. Boot, 32 in. Height of body, from ground to bottom of rocker, 27½ in.; from bottom of rocker to top of glass frame, when lowered, 28 in.; from top of glass frame to top moulding, 25 in., and from latter point to top, 2½ in. Length from centre to centre of hubs, 10 ft.

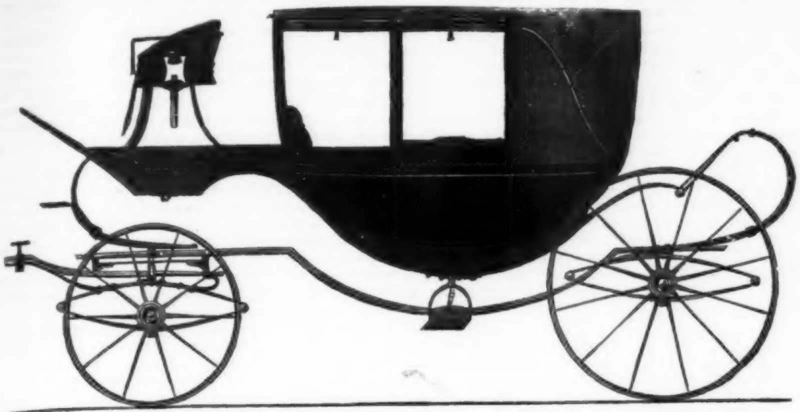
MORTAR TRUCK.

No. 39. *Eighty-Pound One-Man Wagon.*—Dimensions: Width of seat on frame, 18½ in. Width of box, 16¾ in. Wheels, 3 ft. 8 in. x 3 ft. 10 in. Hubs, 2⅞ in. diameter, with bands 5¼ in. long. Spokes, ⅝ in. Track, 3 ft. 8 in. Rims, 7/16 x 1/32 in. Tires, 9/16 in. wide. Springs, 2 plates, 1⅝ in. wide. Axles, ⅝ in.

No. 40. *Fifty nine Pound Skeleton Wagon.*—The chief novelty consists in combining with the reach two bent hickory supports to the seat, which are so formed as to produce a brace in two ways, or both laterally and vertically, and by this construction dispensing with the numerous iron braces ordinarily used, and also with the reaches, as the side-bars themselves form the reaches. The side-bars and bent supports to the seat are rigidly connected at the ends, and form a trusswork to support the seat.

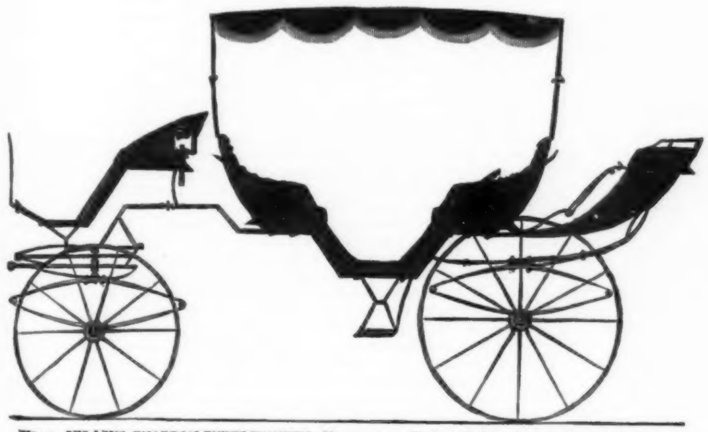
No. 41. *Goddard Wagon.*—Patent axles are used, with coil springs in place of washers. Dimensions: Width of seat-frame, 38½ in. (width of seat for 43 in. bows); width at front, 30 in. Wheels, 3 ft. 8 in. x 4 ft. Track, 4 ft. 8½ in., out to out. Hubs, 4½ x 6¼ in. Spokes, 1 in. Tires, ⅞ x 3/16 in. Rims, 1⅛ in. Axles, ⅞ in.

No. 42. *Piano-Box Top Wagon.*—Dimensions: Width of seat on frame, 24¾ in. Width of box, 22¼ in. Wheels, 3 ft.



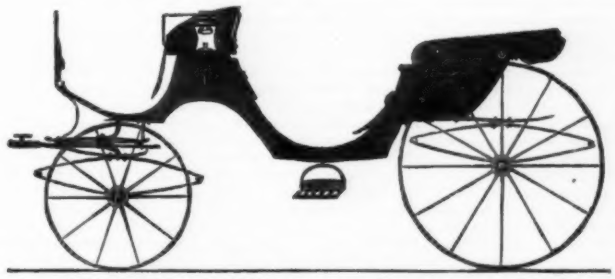
No. 38. KILLAM'S CANOE-SHAPE FIVE-GLASS LANDAU.—Exhibited by H. Killam & Co., of New-Haven, Conn.

No. 42. ENDERS' PIANO-BOX TOP-WAGON.

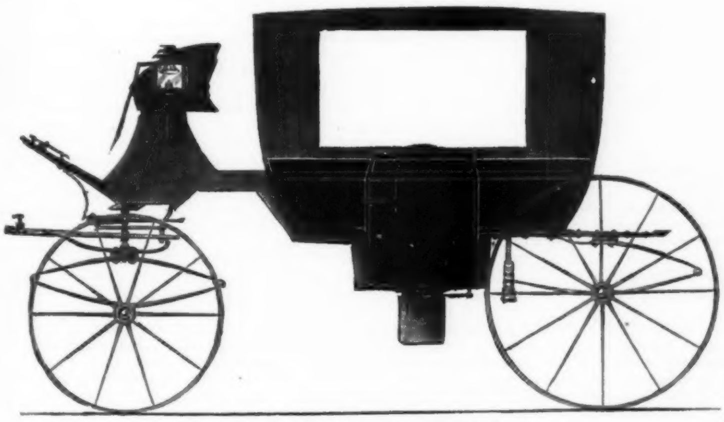


No. 37. VIS-A-VIS PHAETON, WITH RUMBLE.—Exhibited by McLear & Kendall, of Wilmington, Del.

No. 41. GODDARD BUGGY.—Exhibited by Pray Brothers, Boston, Mass.

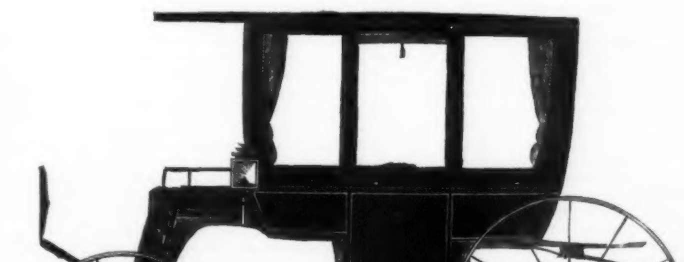


No. 47. WOOD BROTHERS' CABRIOLET.—Exhibited by Wood Brothers Co., of New-York.



No. 36. GOOLD'S DRAWING-ROOM COACH.

No. 43. ROGERS' VIS-A-VIS.—Exhibited by William D. Rogers & Co., of Philadelphia.

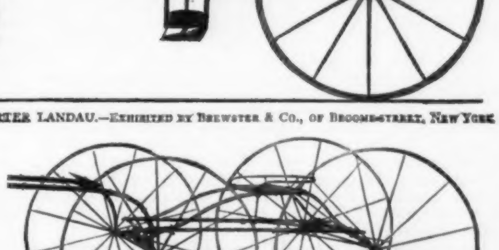


No. 44. MANVILLE'S SIX-PASSENGER ROCKAWAY.—Exhibited by E. Manville & Co., New-Haven, Ct.

No. 46. BREWSTER'S ENGLISH-QUARTER LANDAU.—Exhibited by Brewster & Co., of Broome-street, New York.

No. 45. CONDOY'S SLEIGH WITH ADJUSTABLE HIND-SEAT.

No. 39. RODGERS' EIGHTY-POUND PIANO-BOX WAGON.



No. 40. JONES'S SKELETON-WAGON.

THE INTERNATIONAL EXHIBITION OF 1876.—CARRIAGE EXHIBITS.

9 in. and 4 ft. Track, 4 ft. 1 in. Springs, 3 plates, $1\frac{1}{8}$ in. Hubs, $3\frac{1}{2}$ x $6\frac{1}{4}$ in. Spokes, $\frac{7}{8}$ in. Rims, 1 in. deep. Tires, $\frac{7}{8}$ x $\frac{3}{16}$ in.

No. 43. *Rogers' Vis-à-Vis.*—The door-panels are in a groove—that is, instead of being covered by a lead moulding as used by French builders, the door-mouldings are of wood, made all in one piece with the pillar, which is the more difficult to execute on account of the double sweep of the turn-under. Dimensions: Width at back hinge pillar, from out to out on the quarter rail, 52 in.; on the back, 44 in.; and on the front, 36 in. Width of boot, 32 in. Wheels, 3 ft. 2 in. and 3 ft. 10 in.; 10 and 12 spokes.

No. 44. *Six-Passenger Rockaway.*—This carriage has a full circle fifth wheel 18 in. diameter, with straight bed and mail-axles. There is a single glass in the front of front quarter, which drops. The roof extends 18 in. over driver's seat. Covered steps. Weight, 1190 lbs.

No. 45. *Sleigh.*—The braces are curved to harmonize with the knees, which are bent so that the runner may set square without cutting crooked mortises or tenons, or planing the runner off, thus leaving the latter in better position to receive the shoe, which is made in one piece, and not spliced where the runner usually strikes frozen obstructions.

The special feature is the adjustable back, the lazy-back being so arranged that it can in a moment be taken off or changed to a comfortable back seat for juveniles; and by moving the front seat forward, ample room is afforded for adults, thus making a genteel family cutter.

No. 46. *English Quarter Landau.*—The body measures only 5 ft. 7 in. on the belt-rail; yet owing to a judicious distribution of space it is sufficiently roomy. The top, or head, is so skilfully made that when dropped it lies nearly flat, and does not wrinkle the leather. Total weight, 1245 lbs.

No. 47. *Cabriolet.*—Dimensions: Width of seat, 41 in. Width of back at arm-rail, 40 in. Turn-under of back, 1 in. on each side. Width of dickey-seat, 35 in.; of toe-board, $32\frac{7}{8}$ in. Wheels, 2 ft. 6 in. x 3 ft. 6 in. Hubs, $4\frac{7}{8}$ x $7\frac{1}{2}$ in. Spokes, $1\frac{1}{2}$ in. Rims, $1\frac{5}{8}$ in. Tires, $1\frac{1}{8}$ in. wide. Springs, 4 plates, $1\frac{5}{8}$ in. wide. Axles, $1\frac{1}{2}$ in.

BRAZIL AT THE EXHIBITION.

The interesting exhibits of Brazil in all the principal buildings of the Centennial Exhibition come from an empire which occupies three sevenths of the South American continent, and covers an extent of contiguous territory 3,200,000 square miles—greater than that under any government in the world except Russia. The boundary lines of the empire touch the borders of all the South American republics except Chili. The greatest breadth of territory is 2470 miles, and the greatest length 2600 miles, the coast line being 4750 miles, and extremely varied in aspect and formation. Brazil is, in general, a mountainous country, but it is remarkable for its vast plains, extensive valleys, and large rivers. The highest mountain has an elevation of 10,300 feet above sea level, and there are several above 5000 feet in height. There are no known volcanoes in the empire, although parts of the soil are of volcanic formation. The territory is well watered, the four great fluvial basins being those of the Amazon, the Tocantins, the Parana, and the San Francisco. The Amazon drains 800,000 square miles, or about one fourth the area of Brazil, and has a course through the Empire of nearly 2300 miles. The Amazon is one of the wonderful rivers of the globe. Its waters are emptied into the ocean with such velocity that navigators, after losing sight of land, may yet drink of its waters. Beyond the frontier of Brazil, the Amazon continues to be navigable by steamers for upwards of 1188 miles, in the territory of Peru. The river and its tributaries are navigable, by steamers, through an aggregate length of more than 25,000 miles. The Tocantins has a course of about 1500 miles, and the Araguaya, its principal affluent, extends about the same distance. The Parana, in the Southern, and the San Francisco, in the central part of Brazil, are also large rivers, with numerous affluents. Steam navigation, subsidized by Government, has been established on many of the rivers, and the Government has been engaged for several years in surveys and engineering works, designed to improve navigation or to carry passengers and freight around falls and cataracts, that obstruct navigation. Without these works, however, Brazil, with its forty-two harbors and numerous navigable streams, is well fitted for carrying on foreign commerce and developing its resources in the interior. Most of the rivers are subject to periodical floods, but the flooding of the Amazon does not interfere with navigation, as its affluents do not swell simultaneously.

The enclosure of the Brazilian section in the Main Building consists of a beautiful and brilliant colonnade with ornamented capitals and arches supporting a superstructure of wood painted in rich and well contrasted colors. The façade is similar to the sides, and decorated with painted glass tiles, the whole being in Moresque style of architecture. The Brazilian coat-of-arms is painted on the tiles in front, and the word "Brazil" at the top of the structure, while inside the court are the names of the provinces and the Emperor's monogram.

Minerals of Brazil.—In the northern part of the enclosure there is a section which contains a very full collection of minerals, designed to show the variety of the mineral resources of the Empire. It is not a cabinet collection, selected for the beauty of the specimens or for any exceptional value in their chemical constitution, but is a fair display of minerals as ordinarily found. Of these probably the hematite iron ores are the most valuable.

True coal is exhibited, and there are also specimens of lignites, bituminous schists and peat, of which there are large deposits in Brazil. Gold, which is found in paying quantities, and is exported; platina, iridium, palladium, tellurium, bismuth, and arsenical pyrites, silver, copper, mercury, manganese, and lead are also exhibited. Many of these are found in paying quantities. Tin and zinc have been found in small deposits. There is a large exhibit of precious stones, including diamonds, emeralds, sapphires, rubies, topaz, beryls, black, blue, and green tourmalines, crystals of remarkable purity, fine amethysts, chalcedonies, opals, agates, and jaspers. Among the other mineral deposits exhibited are mica, asbestos, graphite, sulphur, saltpetre, rock salt, alum, building stones, including several kinds of sandstones, granites, and marbles. The minerals are arranged in cases, so that a mere cursory examination shall show the variety of Brazil's mineral resources.

Leather Goods, Hats, etc.—In the next section, advancing toward the central aisle and front of the enclosure, is an exhibition of leather and its manufactures, hats and bonnets, hand and machine sewing, colored silks and woollens, etc. The leather is of all kinds, from fine patent leather to the heaviest sole leather, and appears to be of excellent quality. The boots and shoes made from it are shown in great variety, from the finest in material and workmanship for women to the heavy raw-hide boots for men, and include wooden-soled shoes for the natives. The saddlery, embossed and profusely decorated, is handsome and well made, showing that in this department of industry Brazil can compete fully with all others. The hats of felt and silk are extremely light, and appear to be well made; the needlework is neat, and the tints for silk and woollen goods are clear and pure.

Artificial Flowers and Jewelry.—At the entrance from the main aisle to the Brazilian enclosure is an ornamental case containing handsome specimens of the birds and insects of Brazil, and the beautiful ornaments made from them. From the feathers of the birds are made garlands and bouquets of flowers so natural that they deceive the eye, and from the bugs and beetles, brilliant in color and decorated by nature with gold, are made ear-rings, breast-pins, sleeve buttons, and other articles of jewelry. Nature and art struggle for the mastery in this case, and one finds it difficult to determine which is the more beautiful, the birds of brilliant plumage and the dazzling butterflies, or the decorations made from them by human ingenuity.

Coffee.—A large display of coffee is made in Agricultural Hall, in a pavilion made of raw cotton—another principal product. The coffees are exhibited in their natural state, after being hulled and dried, and include all grades and of course many different forms and colors. They are exhibited in glass jars and cases, tastefully arranged. Prof. Agassiz, while in Brazil, wrote: "More than one half the coffee consumed in the world is of Brazilian growth."

Brazilian Cotton.—The display of cotton at the Exhibition is large, and is attractively arranged, the pavilion in which the coffee exhibit is made being built of and decorated with raw cotton. Some specimens displayed in the pavilion are very fine. The cotton plant has been cultivated in Brazil for centuries, principally in the northern provinces. For a considerable time, however, the culture was on a limited scale, chiefly for want of a market. The rebellion in this country, however, caused a demand for Brazilian cotton, which encouraged the planters and led to the opening of railroads for the transportation of the product to sea-ports, and since then the cultivation of cotton has become an important industry even in the southern provinces. The exports of cotton in 1873–74 amounted to 119,843,077 pounds, valued at $12,997,324.

Sugar.—Samples of nearly all the kinds of sugar cane grown in Brazil, and of the sugars, syrups, and extracts obtained from this product, are exhibited in Agricultural Hall. Sugar, one of the earliest products of Brazil, was, prior to the introduction of the coffee tree, the principal agricultural product. Most of the soil of Brazil is suited to the growth of sugar cane with profit. Many foreign varieties are already acclimatized, and the Imperial Agricultural Institute cultivates on a model farm 21 foreign varieties, and every year distributes a large number of plants. The exports of sugar in 1873 to 1874 amounted to 340,593,327 pounds, valued at $9,767,206, a very large part of the export coming to this country.

Dry and Salted Hides.—These form a prominent feature of the exhibits in Agricultural Hall, the skins of horned cattle, of wild animals, some of them fur-bearing, and of alligators being hung around the boundary of the enclosure. The hides of horned cattle are, of course, the most valuable, and fine specimens are exhibited. Stock breeding may be carried on in all parts of the empire, but the industry has only been developed to any extent in a few of the provinces. It is estimated that there are at present in the empire 20,000,000 head of horned cattle. Large quantities of hides are used in Brazil in manufactures which the exhibits in the Main Building show have been fully developed, and the exports in 1873 to 1874 amounted to 47,602,143 pounds, valued at about $6,357,447.

Tobacco.—Fine specimens of leaf and manufactured tobacco are exhibited. Tobacco grows wild in Brazil in great abundance, and the fruits of greater care in its preparation and cultivation of late years has been the production of a leaf that competes with that grown in Havana. In 1873 to 1874 the exports amounted to 29,190,825 pounds, valued at $2,954,083.

Caoutchouc or India Rubber.—This valuable product is exhibited among the numerous gums and resins obtained from the trees of Brazil. The provinces of Para and Amazonas, where the *siphonia elastica* from which it is extracted grows profusely from the seaboard to the distance of nearly 2,000 miles inland, furnish the chief supply of caoutchouc. The regular culture of the India-rubber tree has been begun, and the business promises to be a good one on account of the superiority of Brazilian rubber and the numerous uses which may be made of it. The exports of India rubber in 1873 to 1874 amounted to 14,819,890 pounds, valued at $5,847,387.

Building Timbers and Tree Products.—The exhibit of useful woods made by Brazil is wonderful for its variety and value and the beauty of some of the specimens. There are over one thousand specimens in blocks, boards, and logs, cut and planed, and either wholly or partially varnished, to show the grain of the wood and their quality as decorative woods, capable of being polished. Some of the mahogany and cedar lumber is cut in boards the full width of the tree, to show the great size of the lumber obtainable from the immense forests. Among the woods exhibited in Agricultural Hall there are several under the name of jacaranda, or rosewood, which are very fine in color and texture, and susceptible of a high polish. There are also specimens of stone-wood from the Amazon valley; of the copaiba, valuable for the oil which it yields, as well as for its timber; of the Brazil-wood, which is celebrated for the coloring matter it contains; and of bow wood and macaranduba, which are used in cabinet making. From the latter is obtained a white liquid used as milk in tea or coffee, or dried and used as a substitute for india rubber. The bark, which is rich in tannin, is used for dyeing. Logs 100 feet long squared from these trees are not uncommon. Besides these there are from 300 to 400 species of the palm, many varieties of mahogany, cedar, iron-wood, etc. The palms, besides furnishing good building timber, bear valuable fruits, as the cocoanut, and yield wax, oil, starch, materials for cloth and cordage, and the sap, roots, and flowers have medicinal properties. Nearly all the woods are of good texture and suitable for building purposes, and some furnish valuable fibres for ropes, cordage, and caulking purposes. Of these and the resins, oils, dyes, etc., obtained from native trees, there is a large exhibit. The display would be a wonderful one if made by the world, for there is great variety in the texture, color, and grain of the woods, and still greater variety in the useful products which the trees yield.

Vegetable Fibres.—In a handsome upright case made of native woods, there is a beautiful exhibit of vegetable fibres for use in the manufacture of textile fabrics. Specimens of these fabrics were sent to England several years ago for examination by scientists and manufacturers, and provisionally favorable reports having been made on them, the Brazilian Government encouraged Mr. Severino Lourence da Costa Leite in their cultivation. These fibres are taken, some from vines, and others from the inner bark of palm trees. The fibres are said to be superior to flax in strength and elasticity, and easily prepared and cultivated. In appearance they are almost equal to silk. Brazil exhibits many fibres, useful like hemp for the manufacture of rope and cordage, and it is believed that some of those exhibited in Agricultural Hall and not yet utilized may be made available for the manufacture of textile fabrics. They are worthy of study both on this account and because of their great beauty.

Sundry Products.—Raw silk, wools, rums, brandies, and wines, dyes, tree fruits, resins, and oils, prepared for export, are exhibited in profusion, and there is also an exhibit of the cereals, vegetables, etc., raised by cultivation. Wheat, corn, and oats are cultivated with perfect success, but have not become articles of export. In 1873 to 1874 the values of the exports of some of these articles were: Rum, $259,795; horse-hair, $270,223; Para nuts, $292,978; building timber, $488,309.

Silk Culture.—Captain Luiz Reheiro de Souza Rezende makes an exhibit of silk and silk-worms, with the appliances for reeling silk from the cocoons. Here the whole process of silk culture as an agricultural pursuit is shown—beginning with the hatching of the eggs, continuing through the several stages of growth of the grubs from worms one day old to worms three weeks, all of which are shown as they advance day by day—and still further continuing through the spinning of the cocoons by the worms, and the after manipulation of the cocoons and the reeling of the fine and brilliant silk filaments which finally appear in the form of the raw silk of commerce. This exhibit is exceedingly interesting, the display of eggs, worms, cocoons, silk, and reels being ample for the purpose.

The moth is a yellowish "dusty miller," about an inch and a quarter in length. It deposits its eggs on the leaves of the mulberry tree, on which the worm feeds, and in weather like the present they hatch out in a very few days. When they first crawl from the shell they are exceedingly small; but the worms are voracious feeders, and in about twenty days reach the size of our largest caterpillars. To illustrate this growth a case of shelves is shown with the worms at various ages, from those of one day old to those twenty-one days, about which time the worms begin to spin. The filaments are not spun round and round the inside of the cocoon, but in layers back and forth. To secure these filaments the cocoons are put in hot water, which kills the worm and sets free the filament, an end of which is secured to a revolving reel; the filaments from two or more cocoons are made to pass through a disc, which, attached to a spiral spring, keeps up an equal tension, and the cocoon is rapidly unwound; the filaments from the two or more cocoons are collected in one thread. The reels of filaments are emptied and a twist or braid is made of the silk. Many of these hanks are shown in glass cases. In one case are similar hanks from China, Japan, and California, and the Brazilian silk in gloss and fineness is not surpassed by any.

Paintings of the silk-worm establishment of the exhibitor, showing the buildings and the mulberry groves, are hung on the walls of the enclosure. Silk goods are manufactured quite extensively at Rio de Janeiro, Bahia, and one or two other points in Brazil, and the industry is a growing one. In addition to the silk exhibit, Captain Rezende shows a very pretty collection of butterflies and Brazilian bugs, together with porcelain tiles, painted in different colors, and a number of views of Rio de Janeiro and other towns in Brazil.—*Philadelphia Ledger.*

[New York Tribune.]

OUR POPULATION.

THE PEOPLE OF THE UNITED STATES ONE HUNDRED YEARS AGO AND NOW.

The first century of the United States closes to-day. It has been a century of development without parallel in history. The population has increased from 2,750,000 to 44,675,000. The area has been extended from 800,000 to 3,603,844 square miles. The development of agriculture under the pressure of immigration and the stimulus of mechanical invention has been utterly without precedent. The value of manufactures has advanced from $20,000,000 to $4,200,000,000. Foreign and domestic commerce has taken gigantic strides. The marvellous development of mineral resources has not been the work of a century, but of fifty years. There was not a single bank in the colonies in 1776; there are more than 6000 now. Internal improvements and the common school-system have kept pace with immigration.

At the outbreak of the Revolution the Continental Congress ascertained approximately the population of the thirteen colonies, in order that the burdens of the war might not fall too heavily upon any section. The total population was estimated at 2,250,000, exclusive of 500,000 slaves at the South. In 1870 the nation which the representatives of these colonies founded was the fifth of the great empires of the world in respect to population, and it is now undoubtedly the fourth. The Chinese empire in 1870 had 477,500,000 inhabitants; the British Empire, 174,200,000; the Russian Empire, 76,500,000; the German Empire, 40,200,000; the United States, 38,558,371. The average increase in the aggregate population since 1870 in the fifteen states in which a census has been taken is 16 per cent, and at the same rate of increase the total population in 1875 would be 44,675,000, while that of the German Empire, according to the recent census, is 42,757,812. During sixty years (1800–60) the population of the United States increased 593 per cent; that of England and Wales, 121 per cent, and that of France, 37 per cent. The great factor of the marvellous growth of our population has been immigration. Annexation has contributed very little. The purchase of Louisiana, Florida, California, and New Mexico brought in fewer than 150,000 inhabitants, and the acquisition of Texas and Oregon merely restored to citizenship those who had emigrated from the United States.

The colonies were founded in a religious age under the best possible conditions for ultimate self-government. Nearly all the early settlers belonged to the industrious middle classes of the Old World. A substantial equality existed among the Puritans in New England, the Dutch in New York, the Quakers and Germans in Pennsylvania, the Swedes in New Jersey and Delaware, the English Roman Catholics in Maryland, the English Churchmen in Virginia, the Nonconformists in North Carolina, and the Huguenots in South Carolina. At the time of the English Revolution of 1688, settlements had been made in all the thirteen colonies except Georgia, and the total population was about 200,000. Growth was slow and unequal, and it was not until 1750 that the population exceeded 1,000,000. During the next twenty years the population of the colonies was doubled, and on the threshold of the Revolution there swept a great current of immigration from Germany and Ireland into Pennsylvania, New York, and the Carolinas,

The first census of the United States was taken in 1790. The result chilled the overwrought enthusiasm of Mr. Jefferson, and he took pains to caution his correspondents at foreign courts against accepting the figures, inasmuch as they fell short of what he thought was the truth. The population was 3,929,214, including 757,208 slaves. From 1790 to 1820 about 250,000 immigrants arrived. A great wave of immigration then swept across the Atlantic.

At the outset America was regarded as a refuge for oppressed labor. The immigrants were accustomed to the simplest forms of labor, and were ready to build canals, and subsequently railroads. The development of manufactures in New England changed the aspect of immigration, and foreigners came to regard the United States as a market for skilled labor. The cheap lands offered under the homestead bill attracted an immense number of industrious farmers. During twelve years an area greater than that of New England was occupied and tilled by 275,000 families under the operation of this act. Interstate migration has been from the first a popular instinct. There was a constant movement from the half-settled states to the unsettled territory, and those who were left behind manufactured for those who were on the frontiers. From 1845 to 1854 there was a great exodus from Ireland and Germany. After the famine of 1846 immigration from Ireland more than doubled, reaching its maximum in 1851. During this period nearly 1,500,000 Irishmen landed in Castle Garden. German immigration reached its highest point in 1854. After the years 1837, 1857, and 1873, there was a most remarkable decline in immigration, a commercial revulsion acting as a wet blanket. The total number of immigrants from 1820 to 1873 was 8,808,141, of whom 2,907,565 were from Ireland, and 2,663,437 from Germany. About 60 per cent (after deducting women and children) were in the prime of life; 46 per cent were trained to various pursuits, and 10 per cent were traders.

Nearly 10,000,000 of our population are foreigners, or the descendants of foreigners. It has been estimated that, if the fusion of elements were complete, of 100 drops of American blood, 25 would be Anglo-Saxon, 27 German, 2 Dutch or Scandinavian, 30½ Celtic, 2 Romanic, and 12½ uncertain. The white, red, black, and yellow races are all represented. In 1870 the ratio of the colored to the whole population was 14½ to 100. The rate of increase of the colored race during the decade was far behind that of the whole population. From 1853 to 1874 a small percentage of immigration has come from China. The total number of Chinamen who arrived during that period was 144,338. The total number of Indians in the United States in 1870 was 383,712, of whom 96,366 were on Government reservations. As regards sex, the population of the United States is nearly equally divided. The doctrine of the comparative sterility of the native population has been quite generally accepted on both sides of the Atlantic, but Dr. Edward Jarvis has recently demonstrated that it is a fallacy based on statistical blunders.

In 1790 one-thirtieth of the population was in cities, and there were only six towns whose population exceeded 8000. In 1870 one fifth of the population was municipal, and there were 374 incorporated cities. The growth of some of these cities has been marvellous. In ten years the population of Jersey City increased 179.7 per cent; of San Francisco, 163.2, and of Chicago, 173.7. During the colonial period the principal occupations were husbandry, lumbering, trading, hunting, and fishing. One third of the labor of the country was employed in timber-cutting. According to the last census nearly 6,000,000 are engaged in agricultural pursuits, 1,200,000 in trade and transportation, 2,700,000 in manufacturing and mining, and 2,600,000 in professional life, and there are 43,000 clergymen, 40,000 lawyers, 62,000 physicians, 126,822 teachers, 2000 actors, 5200 journalists, 1,000,000 laborers, and 975,000 domestic servants. Alexander Hamilton's dream of the diversity of human industry in the New World has come to pass.

STREET PAVEMENTS.

The city of Toronto, Ont., has the good fortune to possess an honest and experienced engineer, Mr. F. Shanly, in charge of its improvements. He, with the good judgment of an experienced engineer, adopted the practical solution of the vexed problem of the best kind of street pavement. He sent to New-York, Boston, and Rochester, examined the pavements there in use, and bases his recommendations on what has been actually proved in those cities. It is very evident the city of Toronto is not going to be bled in the interests of inventors of patent pavements while Mr. Shanly is in charge of its works.

We quite agree with Mr. Shanly, says the *Engineering and Mining Journal*, that the concrete, and patent stone pavements, of which we have examples in this city, are unsuited to the rigorous climate of Canada, for they show very plainly the effects of the frost here, even after a mild winter. The wood pavement has not proved a success here, but this was, doubtless, partly because of defective construction, and because no preservative agent was employed to prevent the decay of the wood. In Europe the wood is not only prepared by treating with creosote, salts of iron or copper, or lime, etc., but the surface of the wood pavement is covered with a coating of asphalt, which, preventing the access of surface water, has added greatly to its durability. We noted recently that so satisfactorily had these wood pavements resisted in the experiments to which they had been subjected in London, that it is proposed there to give them preference, for many reasons, over granite blocks.

From a report which Mr. Shanly has recently made upon the different kinds of pavement proposed for the streets, we make some extracts, for his remarks contain information of value to other cities, and place upon record the present state of the pavement question.

"1. The Guidet pavement of granite blocks, averaging 12 x 5 x 8 inches, laid on 6 inches of concrete and 6 inches of sand, used on Broadway, New-York, costs about $5 per square yard, has been down twelve years, and has had $6000 expended upon it in that time; length, 2½ miles; requires now a further expenditure of $4000. Laid in our streets, this pavement would cost probably $6 per square yard, the material being so much more costly here than there.

"2. The 'Belgian block' pavement, being stones 5 x 6 x 6 inches average, laid on a bed of sand 6 inches deep. It is used on some of the leading thoroughfares in New York, and answers a good purpose. Its cost is about $3.50 per square yard; in our city this would probably come to $4.

"3. The granite blocks used in the city of Boston, 4 x 7 x 8 inches, laid in from 9 to 12 inches of sand or gravel, make an excellent pavement, and the material being close at hand, and comparatively cheap, the cost does not exceed $3.25 per square yard.

"4. The Medina stone pavement, used in the city of Rochester, seems to answer a good purpose. The blocks vary from 2 to 3 x 8 x 8 inches. They are laid upon 16 inches of sand, gravel, or broken stone. This pavement is also extensively used in Buffalo, and costs in either city about $3 per square yard; with us it would probably reach $3.50.

"Second, the wooden block pavement of which there are several varieties, but which may practically be classed as one, may be said to have been abandoned in New-York, its life having been found not to exceed four, or at most five, years, and is now being replaced with some one of the above-named varieties of stone blocks.

"In Boston the experience is more favorable to this kind of roadway, the system there pursued being nearly the same as that adopted on King street in this city, only that the plank foundation is dispensed with, and gravel or sand 6 inches deep, alone used. On this the blocks are laid, and the whole thoroughly saturated with water for the purpose of settling and consolidating the foundation. In some cases the sand is first saturated with carbolic oil, which, being absorbed by the road, adds to its durability. Some of these pavements in Boston are in good order after a wear of six years.

"The cost of this description of pavement in pine or spruce is about $2.25 per square yard. With us, the material being so much cheaper, it can be laid down for not more than $2. Another variety of wooden block pavement is being adopted in Detroit, and to some extent in Chicago and other Western cities; but from what I can learn, there has not as yet been sufficient experience of it to admit of an opinion of its merits. It consists of round cedar or tamarack blocks about 10 inches long, laid on sand or gravel as before, the spaces being filled in with gravel, and in some cases with gravel and tar mixed. It seems probable that this will make a durable roadway; but I am inclined to the belief that the wear of the blocks will be uneven, causing the surface to become rough, like what is known as the cobble-stone roadway.

"Several other varieties are used, but they only differ from each other, and the above, in certain small details of little consequence as to relative costs. Any of them can, I think, be laid down at from $2 to $2.15 per square yard, where the timber used is pine, cedar, or tamarack; and about $2.50 where white oak is used; which, as regards wear, will be superior to all other timbers, though in the matter of durability, otherwise I am inclined to the cedar.

"Third, the next class of pavement used in New-York and Boston, and also in some of the Western cities, is the asphaltum, or bituminous concrete, of which there are several varieties, the most approved, however, being the 'Abbott patent,' used in Cleveland and Brooklyn, and the 'Grahamite,' used in New-York and Boston. From the information received, and the specimens I have seen, I am not inclined to favor its adoption in our climate to any large extent. It has been used a good deal, and it is claimed with advantage in repairing wood and stone pavements, and also in Macadam roads, by coating them with composition to the depth of about three inches. The cost of these seems to vary from $1.75 to $3 per square yard.

"So far I have not touched upon Macadam roadways, but I may shortly state that those in the Central Park, New-York, answer a very excellent purpose. They are built by first laying down about 18 inches of large stone blended with fine sand or gravel 6 inches in depth, of a somewhat smaller stone, also blended as before, then another 6 inches of the ordinary broken stone and gravel, each layer as placed being subjected to a heavy roller, and water freely used.

"These roads cost from $2 to $3 per square yard, and are expensive to keep in repair where the traffic is heavy, but they answer very well for parks and streets where pleasure driving is the main use made of them.

SIDEWALKS.

"In New-York the stone flagging is universal, the cost per square yard being about $3, and of the stone curbs 7 cents per lineal foot.

"In Boston, brick is chiefly used, costing $1.25 per square yard. Where stone flags are used, they are put down at the expense of, and by, the property-holders.

"Concrete, a mixture of tar and gravel, has also been used. The cost is about $1 per square yard, but the experience of it is not satisfactory.

"In our climate brick is not admissible, and the concrete would seem, from our own experience of it, to be equally objectionable. The stone flags are very expensive, and in our climate apt to crack open and be displaced by the frost. We are, therefore, brought down to the only alternative—the wooden blocks—the experience of which, in that position, has been very satisfactory. The cost will be not more than $2 per square yard, or probably less.

"Whilst I am not prepared to recommend any pavement which is not, as to quality of material and workmanship, the very best of its kind, I am quite alive to the necessity of exercising a wise economy in the selection, and propose that your choice be made from the above pavements, used in Rochester, or something equally cheap and durable, and from the best variety of the wood, which, I am inclined to think, is the oak block. The asphalt or concrete, I would recommend a trial of, on some short streets, covering with it the present macadam.

"For sidewalks I recommend the wooden blocks, and for curbs, the stone stringer; no new sidewalks to be laid down henceforward on certain principal thoroughfares, to be determined upon in any other way.

"In preparing for these improvements it will, I think, be well to call for tenders for each class, without naming the variety, by which means you will be enabled to get estimates for all kinds, and may, perhaps, be placed in a position to make a better selection than I have—upon our present information—recommended.

"A great deal has been said lately about various kinds of artificial stone, and some offers have been made for the adoption of it, as curbs, sidewalks, etc., and while I would hesitate to condemn it without some experience of its qualities, I would strongly recommend that it be used only after an ample test, made at the expense of the manufacturers, and to the satisfaction of your Board.

"F. Shanly, City Engineer."

WORKING DOGS.

A New-York paper states three men and five dogs are employed by C. Moeller, of that city, in his spike manufactory, when business is good. Two dogs and a man are out of work at present, owing to dullness of trade. The dog treads in a wheel, which, revolving, blows the forge bellows. While one works the others rest. Mr. Moeller has carried on his business by aid of canine power over seventeen years. He says, "The dogs do their work well, and at small expense; they never go on strike for higher wages, have no labor unions, never get intoxicated and disorderly, never absent themselves from work without good cause; they obey orders without growling, and are very reliable."

STEEL RAILS—ENGLISH EXPERIENCE.

At the meeting of the Institution of Civil Engineers, held in London, England, May 23d, Mr. R. Price Williams read an interesting paper on "The Permanent Way of Railways." In 1865 the average life of iron rails in England was shown to be only three years.

In 1868 the half-yearly reports of the railway companies were required to be prepared according to a uniform system, and the distinction was then abolished between the maintenance and renewals. The average cost of the maintenance and renewals of the permanent way on the Great Northern Railway, during 1868, was £124 per mile of single line, and the net cost of relaying a single line with iron rails was £1371. Dividing the latter amount by £124, gave eleven years as the average "money life" at that time. In 1875, when steel rails were used, the cost of maintenance and renewals per mile of single rail was £184.78, and the net cost of relaying a single mile was £1626, giving a "money life" of only nine years. The diminishing of the "money life" during the last ten years, however, is attributable to the increased labor in preserving the substructure of the road, the cost of maintenance amounting to four times the amount of renewals. So, when the nine principal railways of Great Britain were considered, it was found that the "money life" was least on the Lancashire and Yorkshire Road, being only 6.66 years; while on the Southeastern it was greatest, being 10.50 years. The average "money life" of the roadway on these roads was 7.61 years during the last ten years; and in 1875 it was 7¾ years. The author estimated that every year's increase of the "money life" of the road was equal to an addition of one-fourth per cent interest on the capital, and hence was an important matter. Of course, since the life of rails depends upon the amount of traffic passing over them and the speed of trains, no conclusion of value can be arrived at without a knowledge of these points, and they have not yet been clearly set forth. During the last ten years 85 per cent of the mileage of the Great Northern Railway had been renewed, and the average life of rails was nearly 16 years; making the average cost of renewals per annum £139.55 per mile of single line. Steel rails were first used on the London and Northwestern Railway about the year 1862, and, since they are not worn out, the estimate of their probable duration is based upon the wear as compared with the tonnage passing over them. It was shown that a wear of one sixteenth of an inch corresponded on the London and Northern Railway to a traffic of 9,370,777 tons. In the Maiden Lane tunnel a wear of one sixteenth of an inch of the rail corresponded to a varying traffic of 5,251,000 to 31,061,000 tons. On the Great Northern Railway steel rails laid near Harnsey, in 1866, showed a wear of fifteen hundredths of an inch for 66,547,000 tons, equivalent to 27,727,000 tons for the wear of one sixteenth of an inch. In the Metropolitan (Underground) Railway, which was opened in 1863 and equipped with steel rails, the greater part of the rails had been worn out, and in some cases thrice renewed, owing to the enormous traffic. In the tunnel it was found that rails subjected to continuous damp wore out much sooner than those which were kept dry

The character of the rails was also discussed, and the conclusion arrived at that the hammered ingots were inferior to those which were simply "cogged" before rollling.

In conclusion, the author of this interesting paper expressed the hope that in future steel rails would be made of such uniform quality as would insure as an average the maximum quoted above, or about 30,000,000 tons for a wear of one sixteenth of an inch. With such material the average life of a steel rail would be about 300,000,000 tons of traffic. Of course, the varying endurance of the rails mentioned depended very much upon the qualities and constituents of the rails used; and it is quite probable that the experiments now in progress will determine pretty exactly the constituents of rails which will give the most wear for a given cost.

NEW PROCESS FOR IRON.

This new process has been patented by Mr. I. Lowthian Bell, of Rounton Grange, who says in his specification that hitherto it has been found impracticable to obtain a malleable product in the Bessemer converter or from the Martin-Siemens' furnace from certain qualities of pig-iron; and that his improvements consist in taking such iron as it comes from the converter or furnace, adding to it spiegel iron, and transferring it into a pudding furnace, where it is worked either by manual labor or by mechanical means, the product being finished as puddled iron.

In the substitution of mechanical for hand puddling in furnaces known as rotary, considerable difficulty has been experienced in preserving from the action of the heat the lining which serves among other purposes as a protection to the iron casting of the structure itself. In a great measure this action is due to the presence of silicon in the pig-iron under treatment, which being oxidized during the operation attacks the oxides of iron constituting the lining in question.

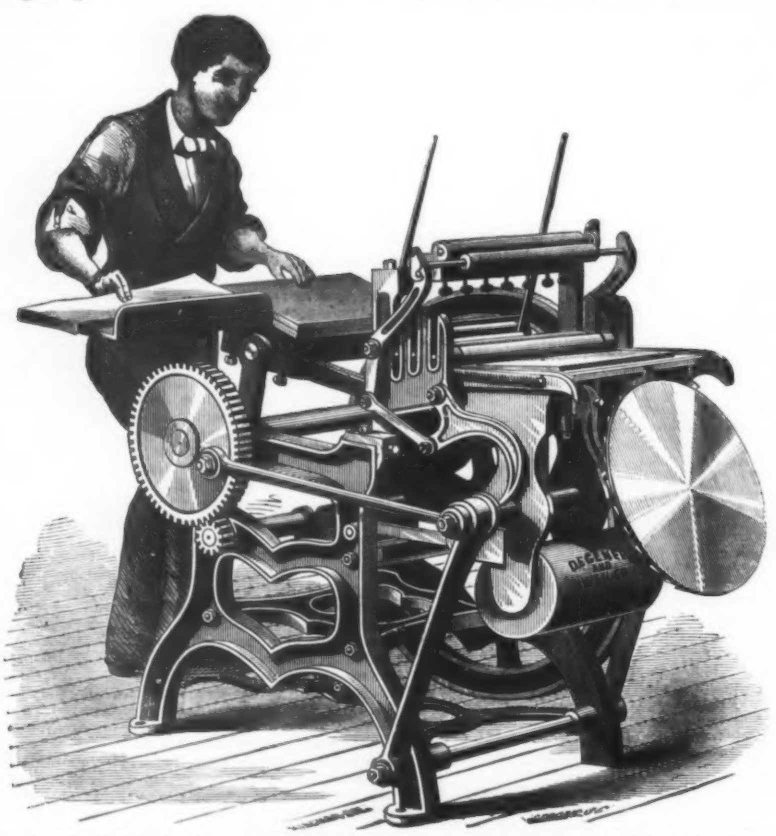
The new process consists in submitting crude iron intended to be used in such furnaces as those described, by preference from the blast-furnace direct to the action of a current of air. This is easily effected in a piece of apparatus known as the Bessemer converter. The extent to which this operation has to be carried will depend on the quantity of silicon contained in the pig-iron. When this amounts from 1½ to 2 per cent, five minutes' exposure to a blast of 15 to 20 lbs. on the square inch will suffice.

When the metal has been blown to an extent desired, the metal is passed, by preference it is run, direct into the rotary puddling furnace, and puddled. In place of stopping the blowing operation whilst the iron still contains sufficient carbon for puddling, the blowing may be carried further, and the carbon afterwards replaced by adding spiegel-iron or other pure cast-iron rich in carbon; this, however, adds somewhat to the cost of the process.

It often happens that the relative quantities of silicon and phosphorus in pig-iron are such that before the former can be sufficiently oxidized, the carbon it contains is burnt off to an extent which interferes with the subsequent operation of puddling. In such a case the iron in the puddling furnace "comes to nature" before the phosphorus is properly acidified and removed by the oxide of iron always present. When therefore it is desired to obtain malleable iron as free as possible from phosphorus, it is found useful to prevent the too rapid expulsion of the carbon by blowing into the converter along with the blast carbonaceous matter, such as ground coke, charcoal, or other similar substances; or, as already explained, the carbon may after blowing be replaced by adding spiegel-iron or other pure cast-iron rich in carbon. On the other hand where malleable iron of a hard character is required, the blast is continued until more or less of the carbon of the pig-iron is expelled, by which means the metal retains more or less phosphorus, which imparts to it the property of hardness or cold shortness, as it is termed.

THE "LIBERTY" PRINTING PRESSES AT THE CENTENNIAL.

MESSRS. DEGENER & WEILER, of New York, exhibit in Machinery Hall five of their Liberty printing-presses, which may be run either by foot or by steam-power. The various sizes are all of similar construction, the design being illustrated in our engraving.



THE INTERNATIONAL EXHIBITION OF 1876.—THE LIBERTY PRINTING-PRESS.

The operation of these presses is as follows: The treadle is connected by a rod to the crank, which is cast solid upon a shaft, carrying on one end of it, and outside of the bearing in the frame, a fly-wheel; at the opposite end of this crank-shaft is the pinion, keyed to the crank-shaft and close to the bearing provided for the shaft in the frame. The pinion, which is of the best Low Moor iron, imparts motion to the large gear-wheel, as shown in our illustration. The bed is secured by and operates from eight points, four of which are on each side of the press. The first of these are the upright arms or supports, pivoted at the bottom upon a wrought-iron shaft running across the press, and fast in bearings provided in the frame, which shaft forms also a pivoted bearing for the end of the treadle. The top of these upright supports provides journal bearing for the shaft carrying the bed, and to which the bed is firmly keyed; outside of the bearing afforded by these supports the bed-shaft is connected by means of a wrought-iron connecting-rod to a crank-pin provided on the large gear-wheel, and it is by the operation of the connecting-rod that lateral motion is imparted to the type-bed. To impart at the same time vertical motion to the type-bed, two short connecting-links are attached to the bed (one on each side) and also to the frame, the bolts being fast in the bed and the frame, and a working-fit in the connecting-links—an arrangement which prevents the bed from having any side movement, which is a valuable consideration when doing fine work. The motion thus imparted to the type-bed is that of a quarter circle—that is, so that the face of the bed moves from about an horizontal position to one a little less than vertical, the object being to not approach the vertical position, and to thus obviate the annoyance of type falling out, as is apt to occur if the chase stands beyond the vertical line. The chase is fastened in the bed by a simple thumb-screw operating a small lever-clamp, and may be very readily adjusted, or even have the matter corrected while on the press, because of its lying in a horizontal position, and away from all other parts of the press.

The platen is bolted to a strong frame, which frame is pivoted at the ends of two arms (one on each side) to two similar arms on the type-bed; thus motion is imparted to the platen from the type-bed. The platen-frame is also carried by two cranks, the large end of which is a neat working-fit upon the shaft carrying the large gear-wheel, while the small end is pivoted a working-fit to the platen-frame. The platen is held to the platen-frame by a strong bolt passing through the latter and into the centre of the back of the platen. The impression-screws screw into the platen-frame and pass through into recesses provided to receive them in the back of the platen; the ends of the screws being turned down below the thread by this arrangement, the platen is held very firmly, and without springing it. In altering the impression, the centre-bolt is first loosened or slackened back, the impression-screws are then adjusted, and then the centre-screw is tightened up again. At the time when the impression is about to take place, the connecting-rods are horizontal and near their dead-centres, while the cranks carrying the platen-frame are also horizontal, so that the parts sustaining the pressure due to the impression are both in the position most favorable to receive it—that is to say, it is in a direction lengthwise of those parts tending to impart to them tensile strains. The frames carrying the distributing-rollers, of which there are three, is fast to the main frame of the machine; these rollers are held by slots provided in the frames. At the top of the frames is the ink-fountain, a new form of which is readily adjustable by the use of two instead of eight screws. It is also provided with a hand-crank, by which the fountain-roller can be covered with ink without moving any other part of the press. The ink-fountain is arranged so that it is easily taken apart to clean. The fountain-roller is operated by a cam arm resting against the bed-shaft, which cam-arm carries the ink-roller from the roller in the ink-fountain to the inking table. The ink-table is revolved by teeth beneath, into which a small lever-catch operates, so that the distributing is accomplished by the carrying-roller, the revolving of the table, and the three rollers already referred to.

The type-bed is balanced by the weight shown, and the crank and treadle are balanced by a counterbalance weight on the fly-wheel. The paper-grippers are fastened to and adjustable in a frame attached to the bottom of the platen, where it is pivoted to the bed, and are operated by a spiral spring attached to and running alongside of the bed; their movement is so arranged as to take hold of and release the paper suddenly, and resume the upright position out of the way as long as possible. This press is strong and well built, and is capable of performing heavy duty with a comparatively light amount of labor. The crank-shaft is made sufficiently long to admit of a fast and loose pulley, enabling the press to be run by steam if it is preferred. The fly-wheel may be run in either direction, and the form may be as large as the chase will admit. Size No. 2 has a special gauge for small cards, which releases them immediately after the impression is taken off, and permits them to fall into a tin box hung beneath the machine. To demonstrate the durability of the press, the first of these presses sold by the firm—which press has been in constant use, and sometimes day and night—is exhibited at the Centennial, and it is yet capable of performing useful duty. J. R.

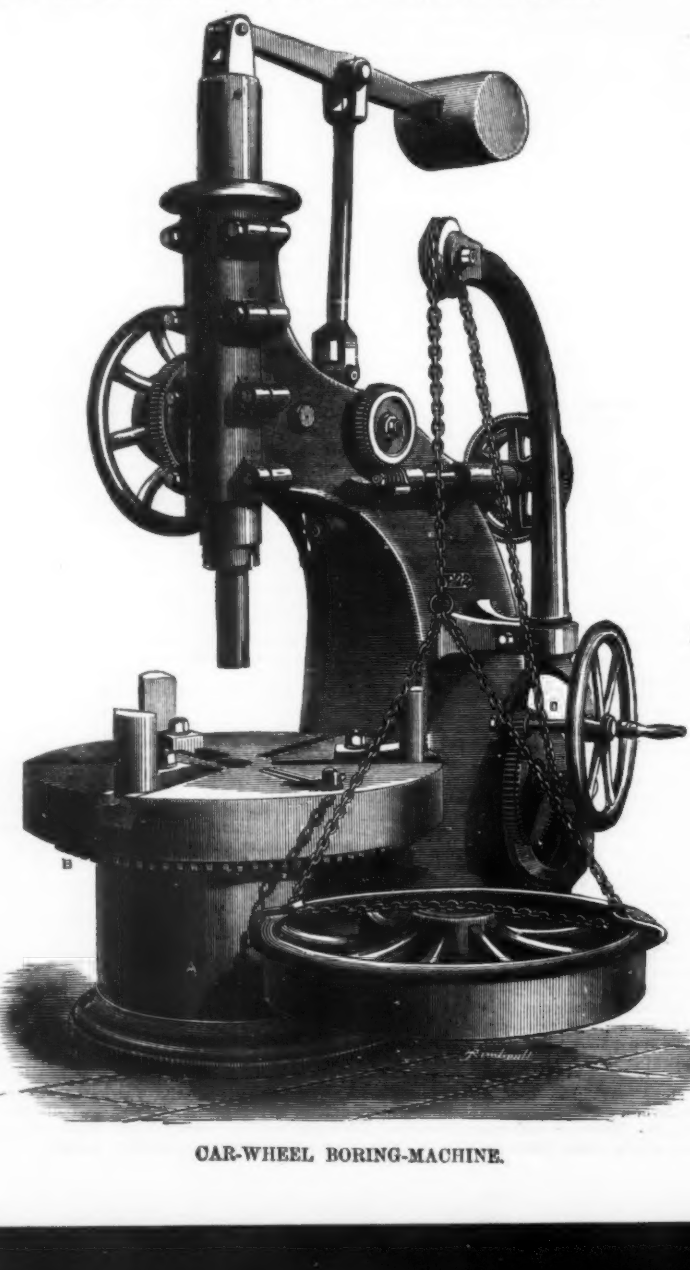
ZINC AS AN ANTI-INCRUSTATOR.

MESSRS. O. BRUCKMANN & SONS, of Heilbronn, in a recent communication to the *Württembergische Gewerbeblatt* give most positive testimony regarding the efficiency of zinc as a preventive of the incrustation of steam boilers. They give the details of three trials of zinc scrap laid in the boiler, all of which were attended with the most favorable results under circumstances where every other means failed. As a result of their experience, they recommend the use of one kilogramme (2.2 pounds) of zinc scrap per month per horse-power; a quantity that would vary somewhat according to the quality of the water.

CAR-WHEEL BORING MACHINE.

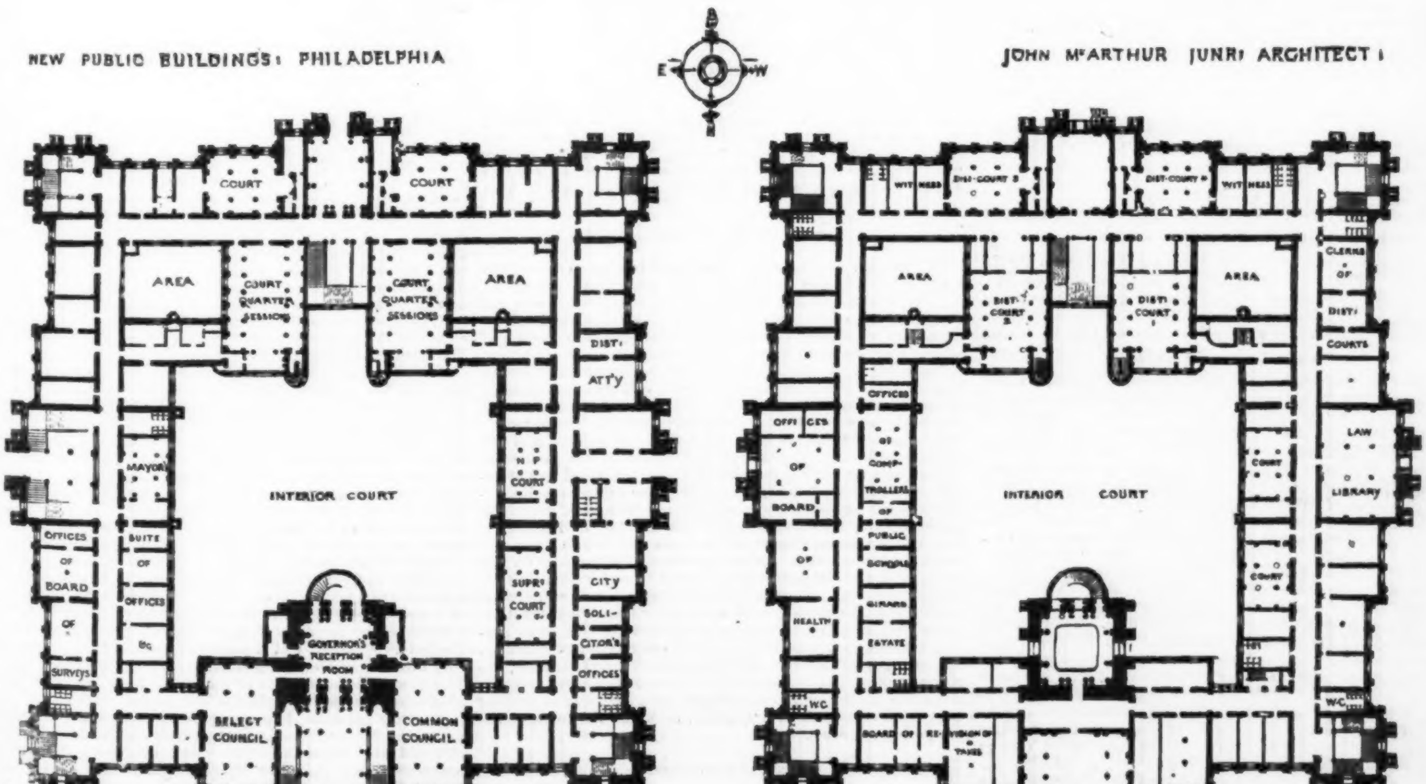
Constructed by Messrs. W. B. BEMENT & SONS, Engineers, Philadelphia.

THE accompanying illustration shows the form and arrangement of Messrs. William B. Bement & Sons' (Philadelphia) standard type of machine for boring the centres of cast-iron railway wheels. The table upon which the wheel is placed terminates underneath in a curved trunk, which takes a bearing in a socket formed inside that part of the frame marked A. The upper part of this trunk is somewhat less in diameter than the bevel wheel B, which rotates the face plate; and at its lower end it is about 9 inches in diameter. The curve given to the trunk is such as to insure equal pressure over its whole surface, and consequently equal wear. Between it and the cast-iron socket, a lining of Babbitt's metal is run in, countersunk holes being formed in the sides of the socket to hold the metal in place. The wheel to be bored is held in position by the three radially sliding blocks in the top of the face plate, simultaneous and equal motion being imparted to them by means of gearing actuated through the key C. The face plate is caused to revolve by bevel gearing within the frame driving off the coned pulleys D. By the same means the spur gearing, worm and worm wheel, feed down the cutter-head, which does not revolve, to the work; a quick return motion is also provided, the cutter-head being provided with a rack. The weight of the former is balanced by a weighted lever, as shown. At the side of the machine a light crane is attached for raising and lowering the wheels to be bored. The machine is capable of boring about 100 wheels per day.—*Engineering.*



CAR-WHEEL BORING-MACHINE.

THE PHILADELPHIA PUBLIC BUILDINGS.—ELEVATION.—(*See next page.*)



THE PHILADELPHIA PUBLIC BUILDINGS.

Mr. J. McArthur, Architect.

Designs for a new Municipal Building were advertised for on the 5th of April, 1869; and, on the 1st of September following, plans and drawings had been received from seventeen different architects.

The first premium was awarded to John McArthur, Jr., architect, of Philadelphia, who was afterwards appointed architect of the work. The contract for the granite basement was awarded for $515,500. The contract for the marble work of the superstructure was awarded for $5,300,000; and the first block set in the walls July 3d, 1874.

The architecture of the new Public Buildings is essentially modern in its leading features, and presents an example of "Renaissance" architecture modified and adapted to suit the requirements of an American city. This immense building is located at the intersection of Broad and Market streets, in the city of Philadelphia, on the site originally set apart for the purpose by William Penn. It covers, exclusive of the court-yard, an area of nearly 4½ acres, and consists of one building surrounding an interior court-yard. As we stated some time ago, the area of the Public Buildings exceeds that of the Capitol at Washington by 2809 square feet; the new State House at Baltimore, by 100 000 square feet; and the Albany Capitol, by 44,341 square feet. The north and south fronts measure 470 feet, and the east and west fronts 486½ feet, in their extreme length. It is surrounded by a grand avenue 135 feet wide on the southern, eastern, and western fronts, and one 205 feet wide on the northern front.

The four fronts are similar in design. In the centre of each, an entrance pavilion of 90 feet in width rises to the height of 185 feet, having receding wings of 128 feet elevation. The fronts terminate at the four corners with towers or pavilions of 51 feet square, and 145 feet high. The exterior is rich in detail, being decorated with columns, pilasters, pediments, cornices, enriched windows, and other appropriate ornaments. Archways of 18 feet in width by 36 feet in height, opening through each of the four central pavilions, constitute the four principal entrances, and at the same time afford passages for pedestrians up and down Broad and Market streets directly through the buildings.

The basement story is 18 feet in height, and stands entirely above the line of the pavement. Its exterior is of fine white granite, of massive proportions, forming a fitting base for the vast superstructure it supports. The exterior of the building above the basement embraces a principal story of 36 feet, and an upper story of 31 feet, with an attic over the central pavilions of 30 feet, and over the corner pavilions of 12 feet; all of white marble from the Lee Quarries in Berkshire County, Mass. The small rooms opening in the court-yard are each subdivided in height into two stories. In the centre of the group, a court-yard of 200 feet square affords light and air to all the adjacent portions of the building. From the north side of this space rises the tower, the foundations of which are laid on a bed of solid concrete 8 feet thick, at the depth of 20 feet below the surface of the ground; and its walls, which at the base are 22 feet in thickness, are built of dressed dimension stones, weighing from 2 to 5 tons each. This tower, which is so deeply and so strongly founded, is 90 feet square at the base, falling off at each story, until it becomes an octagon of 50 feet in diameter at the springing of the dome, the apex of which is 475 feet from the pavement. A statue of William Penn, 35 feet in height, will crown the structure, and complete the commanding altitude of 510 feet, making it the highest tower in the world.

The entire structure will contain 520 rooms, giving ample provision for all the legislative, executive, and judicial departments of the city government. Every room in the building will be well lighted, warmed, and ventilated; and every part of the structure will be absolutely fire proof. The several stories will be approached by four large elevators, located at the intersections of the leading corridors. In addition to these means of approach, there will be large and convenient stairways in the four corner buildings, and a grand staircase in each of the central pavilions on the north, south, and east fronts, as shown in the plans.

The excavations for the cellars and the foundations required the removal of 141,500 cubic yards of earth. The preparation of the ground for the excavations involved the change of the gas pipes, and of two water-mains of 20 and 30 inches in diameter, so that they might pass entirely clear of the foundation walls.

For the above and the accompanying illustrations we are indebted to the *American Architect and Building News.*

[London Times.]

LOAN COLLECTION OF SCIENTIFIC APPARATUS, KENSINGTON MUSEUM, LONDON.

In the educational collections, Germany and Russia divide the palm. The most general collection is that contributed by the Committee of the Pedagogical Museum of Russia, which indicates most clearly that in no country is the value of scientific instruction more appreciated than in Russia.

THE FIRST STEAM CYLINDER.

On leaving the educational collections the objects which strike us on the right and left respectively are Stevenson's "Rocket" and "Puffing Billy," lent by the Commissioners of Patents. These require no comment; but the next objects on the left and right are now exhibited for the first time in England. We refer to a steam cylinder by Papin, bearing the date 1699, sent over from the Royal Museum of Cassel, and a collection of Watt's original models of various parts of steam engines contributed by Mr. Gilbert Hamilton The steam cylinder, which was made at Cassel, is almost the only surviving witness of the works of Papin, from which a series of inventions has sprung, which have completely changed in a few decades our modes of life. How exactly Papin knew the importance of his idea of employing steam as a motive power is clearly demonstrated by his writings. They contain the invention of the piston steam-engine and its application to steam vessels. The cylinder exhibited, undoubtedly the first ever made, was to be employed for a steam engine of peculiar construction, with which a canal connecting Karlshafen with Cassel, on the summit of Hofgeismar, was to be supplied with water. The model of the pumping machine was completed, and some parts of the machinery cast at Veckerhagen, when, in Papin's laboratory, a machine exploded by means of which he was making experiments on throwing bomb-shells by steam; Papin was obliged to take to flight, and died poor and forgotten. Newcomen's engine and Captain Savary's engine also find place, as does Bramah's first hydraulic press.

RESISTANCE OF SHIPS.

In the series of rooms devoted to naval architecture and marine engineering, the first object on the left is a model of the "Faraday," and, after a long line of other models, we come, in the next room, to Mr. Froude's (2,147), illustrating his method of ascertaining the resistance of ships by measuring the resistance of their moulds. This method is now used for Her Majesty's ships. Experiments have shown that the results obtained with the models accord very closely with the ship itself; so that our Admiralty is no longer compelled to make experiments on the scale of 12 inches to a foot—that is, with the ships themselves; it has never before been exhibited, except to those who have been privileged to see Mr. Froude's laboratory at Torquay. We may state that the models, from 6 ft. to 16 ft. in length, are made of hard paraffine; the experimental apparatus employed in working the model includes appliances for designing, moulding, and casting the models, shaping them by automatic machinery, moving them through the water at the required speeds, and automatically recording the leading phenomena of the trial—namely, the speed, the resistance, and the change of level induced by the speed at each end of the model. When the model exactly represents the lines of the ship the form of which has to be studied, it is put into a tank and connected with a dynamometric truck, which runs on a railway about 200 ft. in length, suspended over a waterway 36 ft. wide and 10 ft. deep. The model floating in the water is, as it were, "harnessed" to the truck and travels with it. The towing strain—that is, the force necessary to make the model accompany the truck in its longitudinal progress—is taken during the experiment by a spiral spring, the extension of which, measuring the towing force, is indicated on a large scale by a pen on a recording cylinder. The recording cylinder is driven by the truck wheels, and thus its circumferential travel indicates distance run; at the same time another pen, jerked at half-second intervals by a clock, records time. Other pens actuated by strings led over pulleys record the change of level of the ends of the model. Thus the diagrams made furnish an exact measure of the speed and a continuous record of the resistances and of the change of level of the model throughout the experimental run at steady speed. The truck is connected by a wire rope, with a winding drum, driven by a small stationary double-cylinder steam-engine.

LIGHTHOUSES.

After the avenue of marine models, we pass through another of lighthouses. Among these, first mention must be made of the magnificent series representing the earliest attempts of Fresnel, sent by the Lighthouse Service of France. When Fresnel conceived the idea of substituting lenses for reflectors, he thought of composing them of several pieces, and of calculating the curves of these different pieces so as to obtain a parallel beam. He demonstrated his plan before the Lighthouse Committee in 1819, and was granted the sum of 500f. for constructing a trial lens. He consulted the optician Soleil, who seconded him with much good will, but who could only put at his disposal the limited appliances then in use; glass was at this time worked still by hand, and shaped only into plane or spherical forms. Another difficulty arose from the glass factories being unable to supply in sufficient size pieces of crown glass free from bubbles and striæ; but Fresnel discovered a way of re-melting glass without altering its transparency. He first constructed a trial lens of 35 centimètres diameter (the one exhibited as No. 1). It was given by Soleil to the Academy of Sciences, and deposited at the "Conservatoire des Arts et Métiers." It is composed of 21 pieces, cemented together, and fixed upon a pane serving as a support, and is the first object exhibited. Emboldened by this first success, Fresnel proposed to the Lighthouse Committee, in 1820, to order the construction of a lenticular revolving light apparatus for the Cordouan lighthouse. The principal part of this apparatus was to include eight square lenses of 76 centimètres, forming together an octagonal prism, inscribed within a cylinder of 2 m. diameter. This proposal was adopted, and Mr. Soleil undertook the construction of these eight polygonal echeloned lenses. One of these is exhibited. It is composed of 100 pieces of glass, cemented together, and the flat pane, which in the trial lens serves as a support, has been done away with. Out of these experiments, the modern lighthouses exhibited by France, by the Trinity House (who send the complete lighthouse—some 40 ft. high—for the Little Basses off Ceylon, which is being erected in the grounds), and by the Commissioners for Northern Lights, have sprung.

We have now soundhouses as well as lighthouses, and various arrangements for warning mariners by sound signals, from the portion of the first-class fog-signal exhibited by the Trinity House, to the Holmes "Aurora" fog-horn, for use on board ship, are represented; an interesting series of drawings of the arrangements used in the Adriatic coming from Austria.

TYPE-SETTING MACHINERY.

The first room in the western galleries is devoted to Sections 9 and 10, embracing magnetism and electricity. These include a most remarkable and interesting collection of original apparatus connected with terrestrial magnetism and the development of magnetic and voltaic electricity, and the application of the electric current in the progressive development of the telegraph. This, perhaps, is the most bewildering room of all, for it is the most crowded, and steam-engines in an annexe are used for driving some machines, not necessarily electrical, for which steam-power is necessary. The non-electrical objects driven are M. Pictet's new ice machine, and two machines, the counterparts of each other in the process of type-setting by mechanism instead of by the hand as heretofore, exhibited by Mr. Walter, M.P. The printer has hitherto composed, or built up, the words and sentences of his manuscript letter by letter, each letter being taken by his fingers from its own compartment in the open case before him; and when the matter thus set up has served its purpose on the press, he has again distributed it letter by letter back into the compartments of his case. The two machines now exhibited by Mr. Walter are samples of what, after four years' practical experience, has been found best adapted to the object of getting printing, or type-setting, done entirely by mechanism. The composing machine, with its type arranged in tubes, explains itself. The type-caster is the form which the new system takes, as the simplest, cheapest, and best way of getting type, on its return from the press, back into the tubes of the composing machine.

MAGNETIC INSTRUMENTS.

In magnetism pure, the Teyler Institution at Haarlem contributes one of the largest natural magnets in the world; and M. Jamin has sent over one of his, by which he demonstrates the greater holding power obtained when the magnet is built up of fine laminæ. In terrestrial magnetism are historical dip circles and original recording instruments, as well as many useful for magnetic surveys. Dr. Vogel, of the Sun Observatory, of Berlin, has allowed his complete magnetic equipment, made by Adie, to remain in this country during the Exhibition, and it is now being erected near the lighthouse. The subtle laboratory results of Ampère on the attractive and repulsive influences of voltaic currents upon themselves when passing through metallic conductors in the same or in opposite directions; the delicate elaboration by Oersted in 1819 of the directive influence upon a suspended magnetic needle of voltaic currents passed in a direction parallel to its axis; the development of this by Gauss and Weber in 1833; the work of Soemmering in 1809, who first used currents from the Voltaic pile for telegraphic purposes; of Steinheil, who discovered, in 1836, the practicability of using the earth as the return circuit; of Seebeck, of Berlin, in 1821, on thermo-electric currents; and the labors and discoveries of Faraday and Wheatstone as regards magneto-electricity, and the laws that regulate the transmission of electric currents through metallic conductors, with their practical application to the transmission of intelligence to distant parts, are all brought before us. The chief interest of the collection in this department, as in others, culminates in the original apparatus. In magnetism, the original apparatus of Faraday, which he employed in his experimental researches in the magnetic and diamagnetic character of gases, and in his researches upon the polarity of diamagnetic force, are of great interest. The series of voltaic current generators comprise, among others, the original elements which were employed by Daniell, Wollaston, Sturgeon, and Grove in their researches. Some of the earlier forms of the magneto-electric machines by Wheatstone are contributed from the physical apparatus collection belonging to King's College, London. From the same collection is the original apparatus by which Wheatstone determined the velocity and duration of the electric spark by means of a rapidly revolving mirror, and the elongation of the electric spark discharged through a wire half a mile in length, giving an estimated velocity of 288,000 miles in a second. A wonderful series, illustrating the evolution of the electrometer, contributed by Sir William Thomson, must not be passed over.

TELEGRAPHIC INSTRUMENTS.

The historical collections of telegraphic instruments are of great extent. Here is the original five-needle telegraph of Cooke and Wheatstone, 1838, with its large lozenge-shaped cumbersome dial, and heavy pointers indicating the letters by the convergence respectively of two of the needles, and we here also find the first attempt at the insulation of underground wires, the five metallic line wires required to carry the signals being inserted in grooves cut longitudinally in triangular pieces of wood, and filled in with a resinous cement, and laid underground. Here are also the first electric key and relay instrument constructed by Wheatstone, and Cooke's and Wheatstone's early letter dial telegraph of 1840. Passing along the collection sent by Her Majesty's Postmaster-General, the attention is arrested by two large double-needle instruments in heavy mahogany cases, bearing brass inscription plates at their base. These two instruments, contributed by Messrs. Reid Brothers, were the means of bringing to justice Tawell, the murderer, and the *Times* of that date, 1844, observed that "had it not been for the efficient aid of the electric telegraph, both at the Paddington and Slough stations, the greatest difficulty, as well as delay, would have been occasioned in the apprehension of the prisoner." The Henley magneto machine, or "thunder-pump," has likewise an interest as marking an epoch. The series of coils and needles employed in telegraph apparatus shows the advance made by Holmes in 1848 from the slow pendulous motion of the Cooke and Wheatstone long 5-inch astatic needle combination. Equally instructive is the display of insulators; it must not be forgotten that the early line wires were at times insulated with goose quills. Special attention should also be directed to two early forms of apparatus, which have been the models upon which have been built two of the most valuable and important of modern telegraphic apparatus. The first is that of Gauss and Weber's telegraph (1833), contributed by the German Telegraph Department. In this signal-indicating apparatus, motion is given to a bar-magnet, suspended by a fine wire, by means of the directive influence of a multiplying coil of wire surrounding it, and in the centre of which the bar can oscillate freely. A mirror is attached to the axis of rotation of the magnetic bar, so that if the bar turns to the right or left, the mirror moves with it. The second early form of apparatus to which attention is directed is that of Sykes Ward's telegraph, 1847, in which signals are indicated by the deflection of electro-dynamic coils, free to vibrate over the poles of a permanent magnet. It will be observed that the motor power in Sir William Thomson's syphon recording telegraph is obtained by the motion of a delicately suspended helix of wire vibrating over a soft iron core placed between the poles of a powerful magnet, the motion of this coil being imparted to the delicate marker or capillary tube, which registers the signals upon the advancing paper riband. The early chymical printing telegraph of Alexander Bain, 1846 (incomplete), with its cumbersome wooden box and governor arrangement, also marks an era. In the collection of modern recording telegraphs, the high speed automatic printing instruments of Wheatstone and the syphon recorder of Sir William Thomson are the most interesting.

Mr. Culley is to be congratulated on the completeness of our Post-Office display, and the exhibition of the German Telegraph Department forms a very complete historical collection of apparatus, from the beginning, to the recently-made ingenious contrivances of Messrs. Siemens and Halske, of Berlin. Of the ancient telegraphic apparatus, of which the originals are not sent, such as Gauss and Weber's or Steinheil's apparatus, copies have been forwarded so exactly made that even spots of rust are represented. The automatic Morse recorders and letter-showing telegraphs of Messrs Siemens deserve most careful study. The automatic Morse cylinder transmitter is comparatively new to this country, and combines three important elements in its construction: it composes and transmits the messages automatically by means of a single apparatus, the sending of the message being accomplished by the depression of finger-keys corresponding to the letters required, and it possesses great rapidity, transmitting upwards of 90 messages an hour of the ordinary length. The most important forms of magneto current generators for producing the electric light are well represented.

The original collections of apparatus contain objects which many will be glad to see—the apparatus with which Faraday obtained the magneto-electro spark and his apparatus for magneto-electric induction, also a portion of the battery used by Sir Humphrey Davy in decomposing the alkalies, and much of De la Rive's apparatus used by him both in his researches on passage of the induced current through rarefied gases, and first experiments in galvanic gilding.

GEOM. T .ICAL INSTRUMENTS.

Leaving the gallery where are exhibited the electrical and

magnetic instruments, we come into that containing the geometrical models and instruments. For the purpose of exhibition, these have generally been divided into instruments used in geometrical drawing, those used in tracing special curves, and models and drawings of figures in space. Of the first of these, Mr. Stanley, of Great Turnstile, High Holborn, has sent for exhibition a very complete and perfect collection, containing, one would think, every instrument which can possibly be used by the engineering, mechanical, or architectural draughtsman. In this department is exhibited a collection of ancient mathematical instruments, lent by the Prince of Pless, from his antiquarian museum at Schloss Fürstenstein in Silesia. It is interesting for its completeness as well as for the beauty of workmanship and finish of the instruments, though they date from the beginning of the last century. There are also several beautiful pantographs—instruments, that is, for copying on a reduced or enlarged scale any plane figure—from France and Germany. One of these, by Messrs. Breithaupt & Son, of Cassel, has tubular arms, instead of bars, giving strength and lightness to the whole; but the most perfect and complete instrument is one made by M. Gavard, of Paris, for our own India Office.

Linkages, to which great attention has been recently given, are led off by the compound compass of Colonel Peaucillier, who was the first to show that a straight line can be accurately described by a combination of links; the discoveries of Professor Sylvester and of Mr. Kempe, in the same direction, are also beautifully illustrated by a series of linkage movements contributed by the latter gentleman. For the more complicated curves there are the conograph and cyclоidograph of Dr. Zmursko, of Lemberg, Mr. A. G. Donkin's original model of a machine for producing different forms of a harmonic curve—that is, a curve produced by the combination of two motions, or, more properly, oscillations at right angles to each other, and Messrs. Tisley and Spiller's more perfect form of the same instrument. Messrs. Tisley and Spiller and Prof. Knoblauch, of the University of Halle, show instruments which, though differing in appearance, produce the curves by means of a pen connected with two pendulums swinging in planes at different angles to each other.

Of the models of figures in space there is a most interesting and extensive collection. Many complicated surfaces are geometrically described by the motion of a right line compelled to move according to some definite law. Surfaces of this kind can evidently be well exhibited to the eye by a series of stretched strings, each of which is made to fulfil the conditions of such a law. A numerous collection of models of this description has been contributed by the South Kensington Museum, for which they were constructed some five years ago by M. Fabre de Lagrange. Among the models in wood, plaster, or cardboard, we have a set of the quartic surfaces described by Professor Plücker. These are copies made for Dr. Hirst of the original models made by Epkens, of Bonn. A more extensive series of the same surfaces has been sent by Professor Hennessy, of Dublin, and made by Messrs. Eigel and Lesemeister, of Cologne. Herr Lohde, of Berlin, contributes models of Dupin's and Kummer's cyclide, as well as a most complicated surface made by combining a series of tetrahedra, each one of which gives the least surface capable of passing through four points. A surface of the third order can have drawn upon it 27, and not more than 27 real right lines; but a model of such a surface, displaying all these separate lines, has never, so far as we know, been seen in England. Now, however, the model of one is exhibited, through the kindness of Dr. Wiener, of Carlsruhe. Professor Henrici, of University College, has also contributed the model of a cubic surface on which the 27 right lines are combined nine and nine into three; he shows besides a model of the amphigenous surface of Professor Sylvester. A rough model of Steiner's surface, which has the property that every one of its tangent planes cuts the surface in two conic sections, has been sent by Professor Cayley.

MECHANICAL MOTIONS.

The remaining half of the gallery in which the geometrical models are exhibited is occupied by a remarkable collection of kinematical models from the Royal Gewerbe-Academie of Berlin, and the fact of their being shown here at all is due to the great interest in the Exhibition taken by his Imperial Highness, the Crown Prince of Germany. These models, about 300 in number, have been constructed under the direction of Professor Reuleaux, Director of the Academy, and form scarcely a third of the whole series (all, however, that could be spared) used by him in illustrating his lectures on mechanics; they are also mostly described and discussed in his well-known work on "Theoretische Kinematik." They are all constructed of metal, as they would be in the real machine, all finished to a high degree of accuracy, and work with the utmost ease and smoothness. Every kind of mechanical motion, all the applications of geometry to mechanism, will be here found represented. The whole collection, in its state of completion, and in the excellent workmanship of the models, serves to illustrate, by the amount of money and thought which have evidently been spent on it, the high perfection to which the Germans have brought instruction in technical science. In the next gallery is another collection of instruments illustrating the laws of Statics and Dynamics, and noteworthy for its historical interest; it contains the apparatus employed by the celebrated Dutch physicist 's Gravesande in demonstrating the oscillations of the pendulum, and the parabolic flight of a projectile, and other phenomena of mechanical physics.

CALCULATING MACHINES.

The next section to which we come in this gallery is that of Arithmetic, which, as we have already stated, will be found the first in the catalogue. Necessarily, the appliances for illustrating this branch of science, which can be really called scientific apparatus, are much restricted in number and in character. Of the instruments calculating by machine work the most perfect example will be found in the late Mr. Babbage's calculating machine, or, as he more appropriately called it, difference engine. The machine here shown forms only a part of the original design of Mr. Babbage, but one on this principle was completed by a Swede for the Board of Trade, where it is now used for calculating statistical tables. The Conservatoire des Arts et Métiers at Paris, has sent Pascal's calculating machine, bearing date 1642, and the Royal Gewerbe-Academie at Berlin one formerly the property of the celebrated alchemist and charlatan, Hofrath Beyreis. The most notable modern machine of this kind is the tide calculating machine, exhibited by Sir W. Thomson. This is an embodiment of the idea of Laplace, that the height of the water at any moment might be expressed by the sum of functions of certain periods of the sun and moon's mean motions, and of the inequalities of these mean motions, due to the ellipticity of the orbits of the earth and moon, and of their varying inclinations to the earth's equator. The machine consists of a triangular plate suspended on pivots at its apex and near the middle of its base. Arranged along its two sides are ten pulleys with wheel work behind, which are made to turn relatively to each other, each in its own proper period. The main driving-shaft is fitted along the base of the triangular plate, and gives motion to each of the pulleys by means of endless screws. A fine steel chain passes alternately over the upper and lower pulleys, and is fixed at the apex of the plate. Attached to the free end of the chain is an ink bottle with a glass point, which is in contact with the revolving barrel. The pulleys are capable of being thrown out from their respective centres in order to give the range of tide for the place for which the machine is for the time set. For each change of this kind when the instrument is in action, the pen lies at a different height on the barrel, so that a curve is traced different for each different position of the pulleys. The tide ranges, and the time at which each is at its *maximum* have first to be determined, and have occupied the labors of one of the committees of the British Association for some years. Tidal constants have been determined and are available for prediction by this machine for the following places: In England—Liverpool, Helbre Island (mouth of the river Dee), West Hartlepool, Portland Breakwater. In the United States—Fort Point (San Francisco), San Diego, Fort Clinch, and Cat Island; and in India, for Bombay, Kurrachee, and Tuticorin. The constants are now being determined for Brest and Toulon. The machine was constructed under the superintendence of Mr. E. Roberts, of the Nautical Almanac office, by Messrs. A. Légé & Co., of Hatton Garden. The practical result of the use of this instrument, as stated by Professor Smith in the Handbook, is that "a single operator is enabled to find in an hour or two, by the comparison of actual and harmonic tidal waves, any one of the simple harmonic elements of a year's tide, recorded in waves by an ordinary tide-gauge in the usual manner—a result which hitherto has required not less than twenty hours' computation by skilled arithmeticians."

NEW MICROSCOPIC AMPLIFIERS.

THE Rev. J. H. Wythe, M.D., exhibited two instruments of the above kind at a meeting of the San Francisco Microscopical Society. He observed: "From the great improvements in object-glasses, made within the last few years, it would be reasonable to infer that opticians have reached the limit of perfection in that direction, and that future progress in the power of the microscope must depend mainly upon the eye-piece, or intermediate arrangements of lenses between the eye-piece and object-glass. A conviction of the possibility of improvement in this way has led me to many experiments during the last two or three years, and has resulted in the discovery of the amplifiers herein described, by which the magnifying power of an objective and eye-piece may be increased fourfold or greater, without apparent loss of definition. In the recent edition of 'Carpenter on the Microscope' (1875), the only means of amplification suggested are the employment of deep or strong eye-pieces, and the use of the draw-tube. The aplanatic searcher of Dr. Royston-Pigott (described in the *Microscopical Journal*) is referred to as an amplifier; but I have no experience in its use. The meniscus is said, by one of the journals, to have been used as an amplifier; but I have seen no description of it—the article to which I refer omitting to state whether it is a convex or concave meniscus, or how it is used. The above are all the suggestions I have found in microscopic literature. Experimenting upon the suggestions, I arranged the strongly magnifying eye-piece, which I exhibited to the Society upon a previous occasion, consisting of a deep convex meniscus, in place of the ordinary field-lens in the Huygenian eye-piece. This, tested upon the *Pleurosigma angulatum*, etc., gave excellent results. Further experiments have led to the employment of the two amplifiers I now describe. Either of them is used in a sliding tube between the eye-piece and objective, and the proper position is found by trial. The first consists of a cylindrical lens, conical in shape, with the smaller end concave, toward the object-glass, and the larger end convex. This gives a large increase of magnifying power and excellent definition when used with the strongest eye-piece of Gundlach, or other makers. The second form is better still, and consists of a double concave lens, having a virtual focus of about 1½ inch, at the end of a tube about 6 inches long, at the other end of which is the ordinary negative eye-piece. In both these forms the extent and flatness of the field is quite remarkable, as well as the amount of light, while the amplification is very great. With a periscopic eye-piece of Gundlach, or the No. 3 of the same maker, or with the strongest eye-piece of Crouch, my ⅛th objective defines the semi-lenses on the frustule of *Pleurosigma angulatum*, the markings on *S. gemma*, or *Grammatophora subtilissima*, with a power of 4000 diameters."

MICROSCOPICAL STRUCTURE OF ROCKS.

THIS subject, which was almost unknown a few years ago, becomes now more popular every day. The last investigation in this direction is that of M. Michel Lévy, which is reported in the *Revue Scientifique*, and abstracted as follows by the *Academy:* "In relation to acid rocks, it is observed that under the microscope they present the appearance of being composed of elements formed in succession at different epochs. The oldest crystalline elements are frequently broken, and worn, or rounded, at their edges. They bear unmistakable marks of the mechanical actions that accompanied their eruption. They may be distinguished as ancient crystals, or crystals *en débris*, from the more or less crystalline or amorphous magma by which they are surrounded, and which had its origin at the time of the consolidation of the eruptive rock. This distinction is well marked in porphyritic rocks. These rocks are generally composed of well-developed crystals imbedded in a more or less crystalline paste. This paste is the magma of consolidation, while the crystals are ancient. In ancient granites the crystalline elements of the magma of consolidation have dimensions comparable with those of the ancient crystals, so that it is difficult to distinguish them with the naked eye. The ancient crystals are black mica, amphibole, oligoclase, orthose, and quartz, and the magma orthose and quartz. Recent quartz is moulded on earlier crystals; ancient quartz found in a mass that was still fluid exhibits bipyramidal grains. This form, which some geologists have considered characteristic of porphyries, merely indicates the presence of ancient crystals. The ancient crystals in granites with white mica, and elvans, are chiefly formed of black mica (not abundant), quartz, oligoclase, and orthose; the magma being orthose, quartz, and white mica. The white mica is the latest crystallized, from which it results that the recent quartz was often able to crystallize in its proper form, and thus, like the ancient quartz, exhibits bipyramidal grains. On the borders of massive granites with white mica, or when the rock is injected with thin veins, the magma is finer, and the texture porphyritic. This constitutes elvans, which appear under the microscope completely crystallized and formed of very small elements of quartz and white mica. In granulites the ancient crystals are rare, and the magma composed of united grains of felspar and quartz. In spots of certain dimensions the crystalline elements of felspar arrange themselves parallel to each other, as if to form a more developed crystal. The ancient crystals of the porphyritic group do not serve to classify them. The magma, however, is sometimes entirely crystalline, as in granulites, while in the Permian porphyries it is more or less amorphous, and in optical properties approaches the vitreous rocks. These groups M. Lévy distinguishes as granulitic and petrosilicious porphyries. In granulitic porphyries he finds the ancient crystals composed of black mica, amphibole, pinite, quartz, oligoclase, and orthose. The magma closely resembles that of the granulites, but the elements are generally smaller. Frequently round the ancient crystals are mixtures of orthose and quartz, reproducing, on a small scale, graphic pegmatite. While it is difficult to establish sharp distinctions between different granulitic porphyries, the more recent are usually characterized by a finer microgranulite, and by a micropegmatite of smaller components. In the last rocks of the series, the micropegmatites only form aureoles, or fibrous radiating globules, difficult to resolve under the microscope; but the character of the orientation of the recent quartz is always dominant, and the aureoles and globules become extinct when the Nicol prisms are crossed. In petrosilicious porphyries (eurites of Grüner, Permian porphyries) the magma exhibits a more or less considerable proportion of amorphous paste, extinguished in all directions by the crossed prisms. They also present the texture called "fluid"—that is to say, the débris and the impurities entangled in the paste are unequally distributed, and form more or less colored zones analogous to those exhibited by matters suspended in a moving liquid. In this amorphous paste fibrous globules, like those of total extinction, are frequently observed, but the optical properties resulting from the radiated structure are dominant, and, instead of becoming extinct at a definite position of the prisms, these spheroliths exhibit in all positions a black cross in the direction of the principal planes of the prisms. At the close of the series of Permian porphyries the paste becomes entirely vitreous, and often presents the retreating cracks, roughly concentric, which characterize the perlitic texture. In the midst of this perlite paste the radiating spheroliths are often well developed, and a great part of the pyromerides ought to be grouped with the pitchstones. The acid rocks of the recent period present under the microscope a striking analogy with the ancient ones, but may be distinguished by the nature of their included crystals."

THE MAGNETO-INDUCTION MACHINE.

By Dr. EDUARD ZETZSCHE.

THE principle of these machines (Von Hefner-Alteneck's system) is founded on the fact that a current is induced in a closed circuit when a portion of such circuit is introduced between a magnet whose opposite poles face each other. The direction of the induced current depends on the position of the poles with relation to the direction of the motion. The poles of a permanent steel magnet or of an electro-magnet can be employed; in the latter case, the electro-dynamic principle—discovered independently by Dr. Werner Siemens and Professor Wheatstone—comes into play. By this principle the current of the machine is itself instrumental in exciting the electro-magnetism, by adding strength to the remanent magnetism originally present in the cores of the electro-magnet. The conductor in Hefner's machine is a covered copper wire, which, for an electric light apparatus, is wound in eight separate parts upon a German-silver cylinder, and parallel to the axis of the cylinder. The coils entirely surround the cylinder.

The exterior of the wire cylinder is partially surrounded at opposite sides, above and below, by bent iron bars, these bars inclosing about a third of the circumference of the cylinder, and being at right angles to its axis. There are as many of these bars as the length of the cylinder will admit of, and they form the cores of the electro-magnets. The bars are nowhere at a greater distance from the wire cylinder than is necessary for the latter to revolve. The two sets of bars or poles form magnetic fields of high intensity, through which the wires of the bobbin move. To combine the opposite currents induced in the separate coils into a current of common direction the circumference of the cylinder is divided into eight equal parts, covered with two wires of equal length, coiled one over the other. These wires have sixteen ends, which are led through hollow pivots on the cylinder to a commutator plate that revolves with the wire cylinder. This commutator comprises eight metal sectors arranged on a plate, but separated from each other by narrow radial spaces

At two places, diametrically opposite, a metal wheel is pressed against the commutator plate by means of a strong spring. These two metal wheels form the electrical poles of the machine, and are connected to suitable terminal screws. Between these electrical poles, and joined to them by leading wires, is placed the lamp with its carbon points. From the poles flows on the one side a negative, and on the other side a positive current, always in one direction. As long as this external circuit remains open the machine requires an impelling force scarcely exceeding that necessary to overcome friction. With a closed circuit the quantity of electricity generated by the machine, and at the same time the work consumed by it, increase rapidly; and a small increase in the speed of revolution of the bobbin gives considerable augmentation of the current. The intensity of the magnetic field is increased—and consequently the current-intensity—by a fixed iron core placed inside the hollow wire cylinder. As this fixed position prevents the occurrence of Foucault's currents in the iron core, the machine gains, inasmuch as these currents involve unnecessary consumption of work, and give rise to heating.

In smaller machines, however, in which saving of force is not so important, the advantages derived from fixing the iron core will not always outweigh the benefits of simple construction, and in such instances it is better to let the iron core revolve with the wire coils. At the same time, to reduce these Foucault currents to a minimum as far as practicable, the core should not be made of massive iron, but of coils of iron wire wound on a wooden cylinder. There is described, besides the electric-light machine (which at 450 revolutions per minute gives a light equal to that of 14,000 normal candles), a small machine suited for physical laboratories, which, with an internal resistance of half a Siemens unit, and at two revolutions per second, gives a current equal to that from 10 Bunsen elements joined in series.—*Dingler's Polytechnisches Journal.*

[Nature.]

AMERICAN-INDIAN STONE TUBES AND TOBACCO-PIPES.

DURING the summer of 1873, I found a single specimen of a stone tube, that had been split throughout its entire length, as seen in Fig. 1. Since then, I have had an opportunity of examining several specimens found in New Jersey, and fortunately found two in the locality of my principal labors, in gathering up the scattered relics of the aborigines.

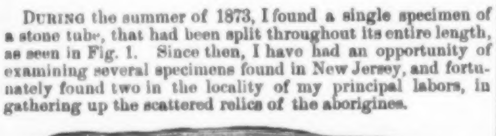


FIG. 1.—ONE HALF NATURAL SIZE.

Figure 1 is made of beautiful veined green and black slate, is six and one eighth inches in length, slightly oval, and has been highly polished. The bore, which is exactly half an inch in diameter, is circular, uniform, and direct. The drilling has evidently been accomplished by the use of a reed with sand and water, and the circular striæ are visible throughout the length of the perforation. This drilling is the more interesting from the fact that the work, commenced at one end, has been continued to the other, and not from either end to the middle, which latter method (and much the more common one) produces an hour-glass contraction at the point of juncture of the two drillings. Six or seven inches, however, was not the maximum depth attempted at drilling in one direction. Professor Wyman, in "Fifth Report of the Peabody Museum of Archæology," p. 13, describes "a cylindrical tube of soap-stone, twenty-two inches long and two inches in diameter, tapering somewhat at either end. This had been drilled from opposite ends, but the two perforations not coinciding, they passed by each other, the bores communicating laterally." We have in this implement, therefore, a single bore at least twelve inches long; which is probably the maximum length, for it is difficult to conceive of a stone to be of greater length than two feet, being of any use.* This is about the maximum of the non-perforated cylindrical stones called pestles; but which probably had other uses than that name implies.

Figure 2 represents a quite common form of ornamental stone implement, but which, unfortunately, are seldom found except in very fragmentary condition. This specimen measures six and seven eighths inches in length, by eight inches, lacking three sixteenths, in breadth. The mineral is a soft sandstone, smoothed but not polished, and free from all attempt at ornamentation. Such specimens, when of less dimensions, have ordinarily been classed as badges of authority, gorgets, or if narrower, as double-edged axes, which could never have been their use, considering the soft material of which they are invariably made. As the perforation of this specimen exceeds in length that of the preceding, I am led to consider this simply as a "winged" tube, and to have had a use identical with such as above described (Fig. 1). While cylindrical tubes, plain or ornamented, are

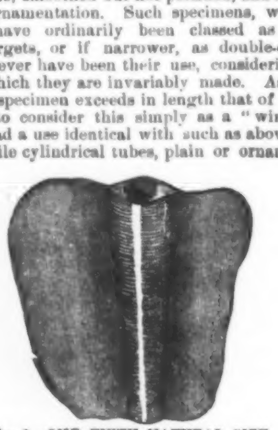


FIG. 2.—ONE FIFTH NATURAL SIZE.

quite abundant in the Southern and Western States, these winged tubes appear to replace them in the Northern and Middle States.

Figures 3 and 4 represent two specimens of tubes, that are of much interest, in that, while of the same general character as the preceding, they have not been bored, but are made of clay which has been moulded when soft, about a straight cylinder, presumably of wood, and then baked very hard. The exposure to fire would necessarily char, if not consume, the encased wood, and so leave a perforation in the clay when baked. This tube has then been brought to its present shape by scraping, and the ornamentation lastly carved upon it. In both specimens, the projective figure has been broken off, but the remaining fragment in Fig. 3 suggests the figure of a

FIG. 3.—ONE THIRD NATURAL SIZE.

mammal, and that of Fig. 4 possibly a human head. On the tube, Fig. 3, will be noticed five short parallel lines. Such rows of short deeply engraved lines are very characteristic of the relics found in New Jersey (see figure of Marriage Emblem in *Nature*, vol. xi., p. 436), and are probably record marks, but of what, on an implement like this, it is difficult to conjecture. The general shape of these tubes, and their diameters render it quite certain that they are not simply the stems of clay smoking-pipes.

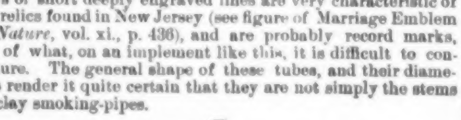


FIG. 4.—ONE THIRD NATURAL SIZE.

These two specimens were found in the same grave, associated with the ordinary weapons of the aborigines: axes, spears, and arrow-points.

Figure 5 represents a stone tube of a pattern quite different from any of the preceding. It is made of very soft soap-stone, is quite smooth, and accurately outlined. It is four and three-fourths inches in length; one and one fourth inches in width at the broad, trumpet-mouthed end, and half an inch in diameter, where broken. The perforation is one fourth of an inch in diameter, and of uniform size throughout. Such trumpet-shaped specimens occur elsewhere. Professor Jeffries Wyman describes one in the report above quoted, same page. He writes: "A fragment of another tubular instrument of the same material (soap-stone) appears to have had a long cylindrical body, and ends in an enlarged and trumpet-shaped mouth, and possibly was used as a horn."

FIG. 5.—ONE HALF NATURAL SIZE.

Figure 5 has faintly engraved upon it a serpent, or what appears to have been one. This representation of a serpent, and the figures on the specimens, Nos. 3 and 4, have probably the same object. Either they represent the owner, the name of the object being that of the possessor of the tube; or, if they were used solely by the sorcerers as "medicine tubes,"* wherewith they blew away disease, then the serpent in the one case, and the figures, now undeterminable, on Figs. 3 and 4, were the "gods" or "devils," through whose inspiration the "doctors" effected their cures. How to explain the meaning of the "wings," of Fig. 2, is certainly difficult, if I am correct in my surmises concerning the other specimens; but these may simply be meaningless ornamentation, just as the broken specimen, Fig. 1, when entire, was just as effectual as any in blowing away disease, provided the suffering patient was made to believe so, by entertaining faith in his physician.

A few words in conclusion upon the use of stone-drills in boring through stone. There is, in the museum of the Peabody Academy at Salem, Massachusetts, several hundred specimens of stone-drills, all of jasper, and varying greatly in length. These specimens, collected by the writer, have been frequently experimented with, and they are found capable of very rapidly drilling in the minerals of which these tubes and "gorgets" usually are made. And when sand and water are used in addition, it is not extremely difficult to drill in mineral of like or greater density. Stone-drills, such as here referred to, are not flat, like a slender arrow-point, but quadrangular (diamond-shaped) when viewed in section. The points of the few perfect specimens I have found, were mostly very highly polished, and the sides showed clearly, in some specimens, the action of sand. These drills vary from one to seven inches in length, and from three sixteenths to over an inch in diameter; or rather the bores they made had these measurements. Figures of such drills are given in vol. vi. of "American Naturalist," pp. 205–214; also by Mr. Evans in "Ancient Stone Implements of Great Britain," p. 290, Fig. 230. None of the drills, however, mentioned by Mr. Evans, are large, and are capable only of perforating thin plates of stone. While convinced that a reed, with sand and water, was most frequently used in deep bores, I can see no reason for doubting that stone-drills were also used; for such specimens are by no means rare, and no other use can be suggested for them.

The various forms of stone implements found in New Jersey, however specialized, appear to be all traceable to others, far less elaborate, and these ruder patterns, as I have endeavored to show, are now found at such depths, as a mile, that they may safely be considered as of greater antiquity and the forerunners of the more finished types, the true surface-found specimens. From this fact I have concluded that the red men of the Atlantic coast of North America reached our shores a palæolithic savage, and when discovered by the Europeans had attained to the neolithic stage of culture.

There is one form of stone implement (and only one) that offers an exception to the assumed rule that the ruder antedate the more finished specimens; that is, the smoking pipes. There are no rude or palæolithic pipes occurring in New Jersey, nor, I believe, in any portion of the country. They are all more or less polished, and so wrought that they must be classed as a neolithic form of stone implement. Among the chipped unpolished implements of the river gravels I have been unable to find any specimen that could be imagined even to be connected with the custom of smoking. There is, however, abundant evidence of improvement in the flint-chipping art having been attained by the red man while an occupant of this country, readily traced in the axes, arrow-points, and other forms of weapons and domestic implements; and such advance is not seen in the fashioning of pipes.

For the reasons already stated, I conclude that the custom of tobacco smoking was introduced or established after the red man had attained to the higher division of the stone age; and that the first pipes were of perishable materials. Such pipes must, I think, have been of wood. Succeeding the use of this, which was necessarily inconvenient, there is reason to believe that a rude clay bowl was attached to the stem, a mere shapeless lump of clay that they would soon learn was rendered somewhat more durable by the exposure to heat. The use of clay bowls might have arisen, too, by the hardening of the earth simply, if the first receptacle for the tobacco was simply a depression in the ground, to the bottom of which was placed one end of the reed, through which the smoke was drawn to the mouth. However this might have been, I believe I have found fragments of pipes so rude in their shape and coarse in their composition as to warrant the belief that such specimens were the forerunners of the durable stone pipes that now occur in scanty numbers among the relics of the red men of New Jersey.

Inasmuch as the use of clay for pipe bowls was not abandoned, there of course exists a vast range of excellence in the workmanship displayed in their manufacture, and many of the fragments that I have found were as artistically ornamented and made of as carefully prepared clay as others were rude and of the coarsest material. These rudest specimens are never found in graves, and seldom met with except when deeply embedded in the soil, suggesting that they were in use before the custom of burying the smoking pipes of the dead with them was established, and, therefore, that they antedate the more elaborately finished specimens, which are occasionally found among the deposited relics of "grave-finds;" but such an occurrence is rare in comparison with the presence of stone pipes under similar circumstances.

While the pipe bowls of stone exhibit a considerable range in the excellence of their finish, there is not sufficient variation to warrant one in considering the more rudely finished specimens as the older. They are all well made and admirably adapted to their peculiar use. Ornamentation was confined, in the vast majority of cases, to the natural markings of the mineral, and not derived from any carving, as is so marked a characteristic of the pipes of the mound-builders. Figure 6 represents a perfect specimen of such plain pipe bowls as I have described. There is no line, straight, curved,

FIG. 6.—PLAIN PIPE BOWL, NATURAL SIZE.

or zigzag, upon it. The red man who made this specimen had utility solely in view; unless the choice of mineral was considered, as giving beauty to the finished pipe. The material of the specimen figured is a pale green slaty rock, veined with black. The variation in shape of such pipe bowls is of course considerable; and supposing each individual to have made his own pipe, the shape was in each case decided by the maker's fancy solely. As in the case of arrow-points, of which a score of patterns occur, so with pipe bowls. One will scarcely find two precisely alike; yet the "family likeness" is very strongly marked.

There does occur, however, a second form of smoking pipe, but much more sparingly than the preceding, differing greatly, both in size and shape. While the two patterns occasionally approach in general outline, they do not do so sufficiently to warrant our considering the one to pass into the other form.

This variety of pipe, of which Fig. 7 is an example, is well known as the calumet or "peace-pipe." The bowl in this case, as a rule, is much smaller, and the labor of the maker has been expended upon the stem-like base, which in every specimen I have seen has been quite elaborately ornamented. The specimen figure is not as much carved as many, but being quite perfect, is represented in preference to fragments of others.

I believe no specimens of "animal pipes," such as are found in the Mississippi Valley, have been found in New Jersey, which fact is interesting, as there is much reason for believing that when the mound-builders occupied the western valleys the red man was already occupying the Atlantic coast; and doubtless some trading was carried on between the two peoples. Therefore, it would be natural to expect that such pipes should occur among our Indian relics; or at least that there was sufficient knowledge concerning them to suggest to the coast Indians the idea of imitating them; but there is no trace of such imitation, I believe. It is their smoking pipes alone, of all their productions in the flint-chipping art, that are dissimilar.

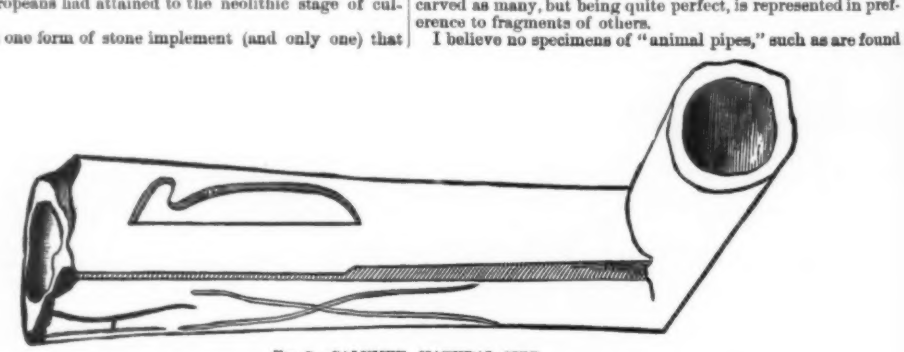


FIG. 7.—CALUMET, NATURAL SIZE.

Through the writings of the earlier missionaries we learn of the peculiar uses and significance of these calumets, which formed so prominent a feature on all important occasions; but whether they were introduced by some other race with whom the red man came in contact, or originated *de novo*, it is impossible to determine; but it is quite certain that the specimens so far brought to light do not enable us to trace the evolution of the calumet from the simpler form of pipe.

CHAS. C. ABBOTT.

TRENTON, N. J., U.S.A., May 6, 1876.

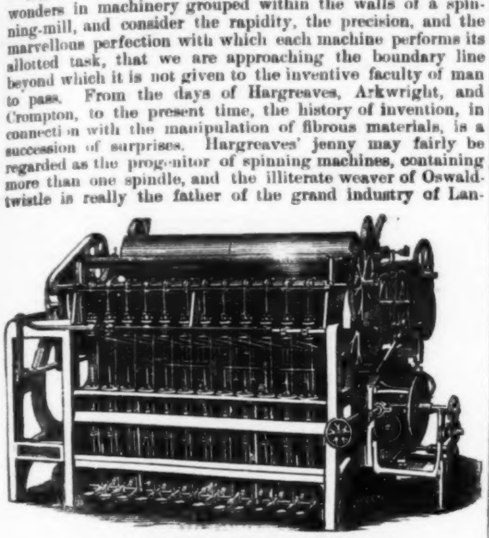
* Mr. Evans, in his "Ancient Stone Implements of Great Britain," remarks that "the tubes of steatite one foot in length, found in some of the minor mounds of the Ohio Valley, must probably have been bored with metal." This depends altogether upon their age. New Jersey specimens of tubes have been found of nearly that length, which undoubtedly were made before the introduction of metal.

* Venegas (Nat. and Civil Hist. of California, vol. i., p. 97, London, 1759) states: "They (medicine men) applied to the suffering part of the patient's body the *chacuaco*, or a tube of a very hard black stone; and through this they sometimes sucked, and other times blew." Quoted by C. C. Jones, junr., in "Antiquities of Southern Indians," p. 363.

THE manufacture of seaweed charcoal is carried on on a large scale at Noirmoutiers, where more than 200 furnaces are constantly at work. The value of the charcoal is from 80 centimes to 1 franc per hectolitre. 100,000 kilos. of fresh weed give 20,000 kilos. of dry material, or 5000 kilos. of charcoal, which, when incinerated, yield from 3500 to 4000 kilos. of saline matter. Weeds which abound in potash, such as the *Laminaria*, contain more iodine than bromine. In *Fucus nodosus*, *vesiculosus*, *fructicosus*, etc., soda predominates, and bromine is much more abundant than iodine.

NEW CONTINUOUS SPINNING MACHINE.

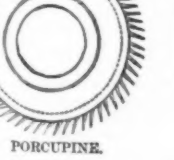
WE sometimes think, when we look upon the numerous wonders in machinery grouped within the walls of a spinning-mill, and consider the rapidity, the precision, and the marvellous perfection with which each machine performs its allotted task, that we are approaching the boundary line beyond which it is not given to the inventive faculty of man to pass. From the days of Hargreaves, Arkwright, and Crompton, to the present time, the history of invention, in connection with the manipulation of fibrous materials, is a succession of surprises. Hargreaves' jenny may fairly be regarded as the progenitor of spinning machines, containing more than one spindle, and the illiterate weaver of Oswaldtwistle is really the father of the grand industry of Lan-



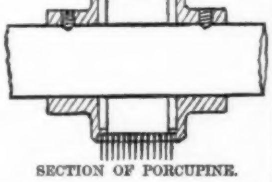
THE CONTINUOUS SPINNING MACHINE.

cashire. This machine of Hargreaves preceded by several years the better developed one of Arkwright, which in its turn created a revolution even greater than Hargreaves. The latter had rendered it possible for the weavers to obtain an adequate supply of cotton weft, to fill into their linen warps, the only way in which the former material could be used, as by no process hitherto invented could the fibre be rendered strong enough to be used as warp threads. This latter object was, however, accomplished by Arkwright's invention, and the public attention being thus brought to bear upon the subject of mechanical appliances to the cotton industry quickly resulted in a succession of discoveries that placed the English textile industry at the head of all existing ones in the qualities of excellence, cheapness, and facility of production. The effect of a better supply of yarns was to lead to an improvement of weaving appliances, and in 1785 the power-loom was invented by Dr. Crompton. For a few years full advantage was hardly taken of these various improvements, as the inveterate prejudices of the operatives, which occasionally led them into acts of violence against both machines and inventors, had to be overcome. This irritation gradually subsided, as a greater number of them became interested in the preservation and development of the new system. To-day it may be regarded as quite extinct amongst the operatives engaged in the manipulation of fibrous materials. Outbreaks of the same spirit are, however, occasionally found amongst the workmen of other trades, the operations of which have more recently been brought within the scope of mechanical appliances, but, judging from past experience, we may reasonably hope that in a short time it will entirely disappear. All circumstances considered, the inventor of the present time may be said to live in a fortunate age, as the instinct of selfishness in humanity induces an early examination of new inventions, and a quick adoption of positive improvements.

We have been led into making these remarks by just having had the privilege of inspecting a new and very ingenious spinning machine, primarily designed for spinning wool, but equally applicable to flax, hemp, jute, silk waste, or noils, and also cotton, but up to the time of writing, we believe it has not been tried with the latter fibre. This machine, which has been brought out by Mr. William Bywater, of Sweet Street Foundry, Leeds, appears to have accomplished an object which has long been desired by the woollen trade, and been an object of research by inventors. This is continuous spinning, as distinguished from the intermittent work of the mule. The manner in which it is attained is very ingenious and successful. The condenser bobbin containing the sliver, as in the mule, is placed upon the top of the machine, and made to revolve at any desired rate, delivering its contents to and upon the tops of a number of small porcupines, arranged at proper distances upon a slowly revolving-shaft. These



PORCUPINE.

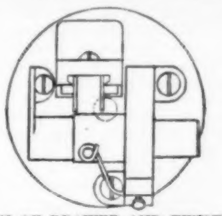


SECTION OF PORCUPINE.

"porcupines," we may explain to our untechnical readers, are bosses, fitted upon this shaft, and covered upon their surface with steel pin points, about a quarter of an inch in length, and which stand out

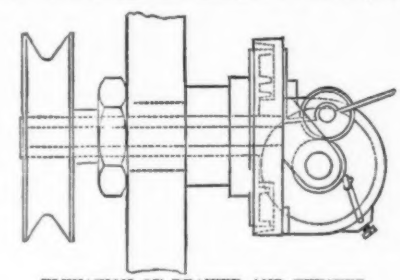
"Like quills upon the fretful porcupine;"

hence their name. The porcupines, on receiving the sliver, or roving, comb and draw the fibres of the wool into parallel lines, and deliver it in an attenuated form to another part of the machine, composed of two very small rollers fitted in a disc. These rollers, one of which is fluted, and the other covered with rubber, constitute a pair of draught rollers, as in the ordinary mule, but are so small in size as to serve only for the reception of one thread. Of course, the principle of the machine requires this. The draught motion of these rollers is obtained by the action of a pair of small toothed wheels, which are covered from sight in the disc. We may pause here to point out the novelty of the invention. The porcupine is a well-known instrument in the woollen manufacturing districts, where, in the machinery pertaining to the woollen manufacture, it performs the same operation, to some extent, as in this machine, but the novelty appears to be in spinning the sliver, or roving, as it is discharged from the "quills." This is accomplished by imparting to the disc before mentioned a rapid rotatory movement, amounting, in fact, to two thousand revolutions a minute. This, of course, can be varied. The disc in its action carries along with it the small draught-rollers through which the sliver is passing. It is thus from the revolution of the disc that the fibre, while being attenuated by the draught-rollers, receives a sufficient amount of twisting to preserve its continuity from being broken. It will be seen from this statement, and from



PLAN OF DRAWER AND TWISTER.

the further one, that there is only about eight inches of space between the delivery point of the porcupine and the point of reception by the rollers in the disc, that a considerable advantage is here gained over the stretch of the mule. From the great amount of twist imparted to the thread in this space, and in which the proper degree of attenuation is obtained, it will be evident that a material of much shorter fibre can be spun, with less risk of breakages than in the long stretch of the mule. And in fact this is proved by the result of a trial. There has already been spun upon this machine a material—the waste of silk noils: that is, the noils of the noils—which has hitherto been used only for upholstery purposes, such as stuffing cushions, chair seats, etc., and which, tried in the mule, could not be made into a thread at all. This fact will demonstrate the great utility of the machine. There is at present a large amount of refuse from all classes of fibres that might be much further utilized if proper machinery existed for its manipulation, but which, however, for want thereof, has hitherto found its way into the waste bag. And if this machine should prove to be the desired instrument for effecting this economy, we may congratulate the inventor upon having conferred a great boon upon the textile industries of the country. Passing on from this point, we next observe that the thread, on its delivery from the



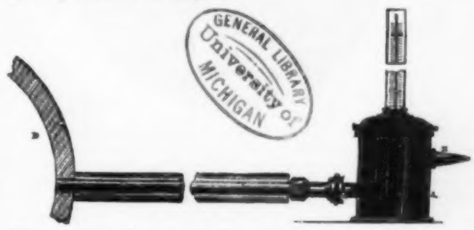
ELEVATION OF DRAWER AND TWISTER.

rollers carried in the disc, is passed on to the spindle, and wound upon tubes in the form of a pirn, or cone. But before it is thus wound upon the spindle it receives the complemental amount of twine. Any quantity of twist can be put in between the rollers and the spindle, as the latter can be driven up to 7000 or 8000 revolutions per minute. The thread is wound upon the spool, or tube, by means of the needle-flyer—an ingenious invention of our American cousins—which will be well known to our technical readers. In order to build a proper cop from the yarn the traverse race differs from that found in roving frames, throstle spinning frames, etc., in having an additional movement. In the machine we are describing, besides the ordinary ascending and descending movements of the traverse, there is a progressive ascent made every journey equivalent to the growth of the yarn cone, or cop, from the deposit upon it of every layer of yarn. Another ingenious arrangement is the attachment of a lever, on which is fixed a couple of breaks, one of which acts upon the spindle and the other upon the revolving disc. The treading of a footplate by the operative simultaneously arrests the movements of both the spindle and the revolving disc until the broken thread is repaired, when the removal of the pressure instantly restores the action of the arrested parts.

We have now described the machine in detail, as it appeared to us after a careful inspection; and it only remains, therefore, to offer a few observations upon it as a whole. Its great, and, we may say, its distinguishing feature, is its continuity of action. When set in motion, it spins its threads and winds them on the spindle at the same time, without the intermittent operations of spinning and winding-on which distinguish the mule, and which entail a serious loss of productive power. This is a great advantage, as a machine of 120 or 130 spindles on this principle, through avoiding the above-named intermittent, will produce an amount of yarn equal to the off-turn of a mule of 500 spindles. It, furthermore, only occupies about one fourth of the space, and requires, perhaps, one half of the driving power. These are important matters to any one contemplating extensions of buildings or renewals of machinery, as, by the substitution of this machine for the mule, structures at present in existence may be made to accommodate a much greater spinning power than at present. The quality of yarn produced by this machine is scarcely distinguishable from that of the mule in its properties of evenness and strength, and, if at all inferior at present, may reasonably be expected to surpass it eventually, if the analogy afforded by the throstle machine and the mule in the cotton trade affords any basis of safe judgment.—*The Textile Manufacturer.*

NEW PYROMETER.

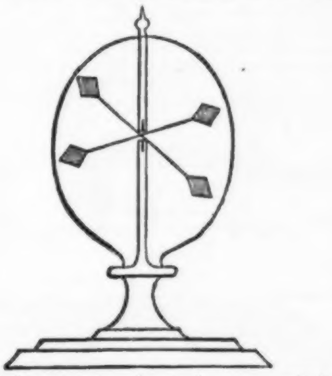
MANY devices have been employed to measure very high temperatures where to apply directly the expansive property of spirit or mercury would be absolutely impossible. There are many operations, however, such as the baking of pottery, and the operation of smelting, in which a knowledge of the amount of heat in the furnace is of prime importance. For very high temperatures, we believe, the rare property of contraction by heat, which alumina possesses, was first applied by Wedgwood. Of pyrometers adapted for ascertaining the temperature of the hot blast, a matter of first importance in the manufacture of iron, several instruments at present in use are based on the elongation of a metal or metals by heat, while two others, Siemens' water and electrical pyrometers, like that invented by Mr. Robert Main, of Glengarnock Iron Works, which we are about to describe, are worked by a "ratio," and admirable instruments so far as efficiency is concerned; but it may be said of the first that, though simple, it is too troublesome, and of the second, that it is much too complicated for ordinary use. Main's pyrometer consists in an arrangement of apparatus wherein the temperatures indicated on a mercurial thermometer or pyrometer bear a known relation to the actual temperature of the blast itself, so that the numerical relation being ascertained, the readings of the mercurial thermometer or pyrometer indicate the actual temperature sought to be measured; it being here explained that the temperature of the blast is too high to be directly measured either with a thermometer or pyrometer, the high temperature either rendering the indications inaccurate or destroying the instrument when directly applied. The apparatus constituting this invention consists of a hollow chamber, preferably double cased, the space between the casings being filled with asbestos, or other substance of low conducting power. This chamber is placed at any required distance from that point of the hot-blast main in which it is desired to a certain the temperature, and is connected thereto by a tube of ½ inch diameter, which conducts the hot blast into the chamber. The distance for a blast of 800° to 1000° F. need not exceed 6 feet. The chamber is also provided with an exit through which the hot blast escapes. The chamber may contain a second smaller chamber or receptacle in which the thermometer or pyrometer is placed, but this may be dispensed with. In the case of using a large pipe for conveying the blast the chamber arrangement may be dispensed with, in which case the thermometer or pyrometer is placed in a hole in the pipe.



The accompanying figure shows the whole arrangement in section. D represents the blast-pipe, and A the apparatus, which consists of three concentric cylindrical vessels of copper or brass. In the inner chamber a delicate thermometer is placed and the hot blast, conducted by the tube C from the pipe D, circulates through the second chamber, passing out by the tapered nozzle E. The outer space is filled with a substance of low conducting power. The temperature indicated by the thermometer does not, of course, represent the actual temperature of the hot blast; but to ascertain this it is only necessary to insert a metallic pyrometer in the hot-blast pipe D, and compare the relative indications, in order to fix a ratio. Any ratio desired may be obtained by a simple adjustment of the bore of the tapered nozzle. When the object is only to regulate the temperature of the blast this adjustment is not required, it being sufficient to note the degrees indicated by the thermometer when the blast is at the ordinary working temperature, and thereafter maintain it at that point. This apparatus is extremely simple, and can be easily fixed. It records continuously the temperature of the blast passing through the pipe to which it is connected, and, unlike metallic pyrometers, is not liable to get out of order.—*Iron.*

THE RADIOMETER.

THE members of the Photographic Society of France were lately very much interested by the presentation of the "radiometer" of Mr. Crookes. Although this pretty little instrument has been the subject of much controversy in England and Germany, still it is very little known in France even at the present day. The radiometer presented to the Society was of the form and size of a large swan's egg, and made of blown glass. In the centre is a pedestal of the same substance, and rising half-way up the egg. Another pedestal descends from the top and meets the lower one to within about an eighth of an inch. The two ends of those pedestals are hollow for about a quarter of an inch; the pedestals are employed, the lower one to support, the upper one to hold a light steel axis, to which is attached a kind of windmill sail, made of four pieces

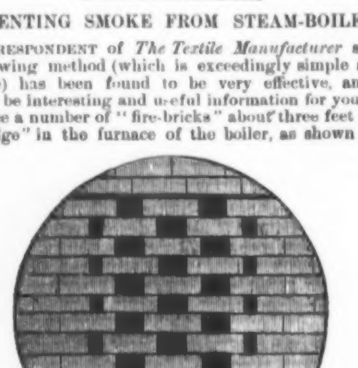


of very thin mica, a quarter of an inch square, and of exactly the same weight; one side of the mica is painted black and the other is silvered. This kind of four-sail mill is placed in perfect equilibrium between the two pedestals or pillars, a vacuum is then obtained, and, what is extraordinary, if the apparatus be placed in sunlight, it will revolve with astounding rapidity; if put in the shade, it will turn slowly; if in the dark, it will remain stationary. It might be supposed that the great stumbling-block to photographers was now removed, and that the actinic power of light could now be measured with precision, and that they would now be enabled to expose their models the exact length of time at any hour of the day without making a single error. Alas! it was soon discovered that not only light but heat had a great influence upon this instrument. Nevertheless, I am of opinion that we ought not to go to an excess in an opposite direction and cast it away as useless, because it does not fill up the conditions of superiority with which we were pleased at first to endow it in our enthusiasm; with a little patience, common sense, and a few experiments, the instrument even as it is would render great service to photographers. A cross, star, or other sign could be painted on one of its sails, and the instrument be fixed in a corner of the studio. Now, if a certain number of observations were made daily of the number of rotations per minute at a certain hour with the temperature at that moment, together with the time required for the exposure of the wet plate employed to make the portrait of the sitter, if all this were noted down carefully for a short time, the value of the

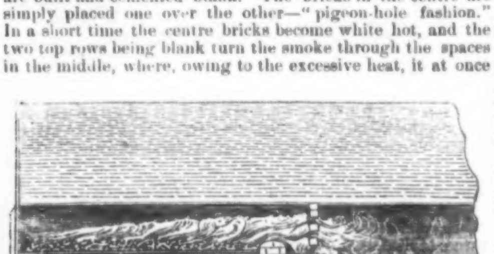
instrument would soon become apparent, a table could then be drawn up for the time of exposure required at a certain temperature, the instrument making so many revolutions per minute.—*French Correspondence of the Philadelphia Photographer.*

PREVENTING SMOKE FROM STEAM-BOILERS.

A correspondent of *The Textile Manufacturer* says:—The following method (which is exceedingly simple and inexpensive) has been found to be very effective, and will doubtless be interesting and useful information for your readers: Place a number of "fire-bricks" about three feet behind the "bridge" in the furnace of the boiler, as shown in the



subjoined sketch. The outside and two top rows of bricks are built and cemented blank. The bricks in the centre are simply placed one over the other—"pigeon-hole fashion." In a short time the centre bricks become white hot, and the two top rows being blank turn the smoke through the spaces in the middle, where, owing to the excessive heat, it at once

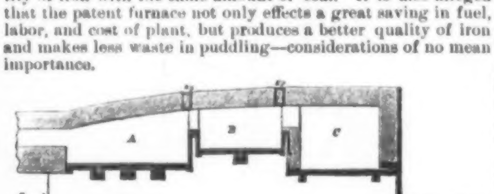


PREVENTING SMOKE FROM STEAM-BOILERS.

ignites the gas and thus consumes the smoke. The "apparatus" certainly slightly impedes the draught, but where there is a good draught to the boiler the difference is imperceptible. However, it is so inexpensive that any one may try the experiment without any outlay of capital beyond the cost of a few bricks.

NEW PUDDLING FURNACE.

The process of freeing pig-iron from the carbon and oxygen which it has acquired during smelting is admittedly open to many improvements. It is undoubtedly the most arduous in the iron manufacture, as far as the workman is concerned; and in the ordinary forms of the operation, much greater economy in the fuel expended might be realized. A well-known but not very frequently applied device consists in heating the metal before it is passed into the furnace. Mr. Middleton, of Leeds, Eng., in this new furnace melts the pigs in a separate chamber. Considerable economy in fuel is thus secured, and the pigs are perhaps to some extent purified. The cost of its application is a matter of importance; and it is claimed that while new furnaces can be erected on this principle at a cost little over that of the more primitive apparatus, the expense of applying the invention to furnaces of any of the old types is also so slight that it would be recouped by a few days' work, inasmuch as one puddler with two underhands may be expected to turn out twice the quantity of iron with the same amount of coal. It is also alleged that the patent furnace not only effects a great saving in fuel, labor, and cost of plant, but produces a better quality of iron and makes less waste in puddling—considerations of no mean importance.



NEW PUDDLING FURNACE.

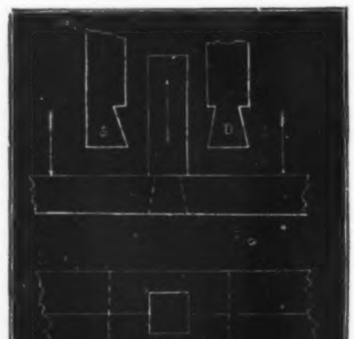
The engravings illustrate the following particulars: The furnace is similar to the old style of furnace, excepting that between the puddling-chamber A and the fire-grate C is fixed a melting-chamber B, wherein the pig metal is brought into a molten state. The heat first enters the melting-chamber B and converts the pig into a fluid state, which is then run into the puddling-chamber A by means of a channel or spout D. While the molten iron is being worked, the melting-chamber B is again charged with pig, which, when melted, passes into the puddling-chamber A, as before, and so on in succession, thereby keeping the puddling and heating chambers, A and B, continuously at work. After the fire is first fed, the above process consumes the whole of the smoke; and the heat generated in the melting-chamber B (which in the old process escaped up the chimney) is utilized in the puddling-chamber A. When the metal is required to be refined, a blast E is introduced into the melting and puddling-chambers in such a position as to produce the required heat upon the metal.

It is intended to apply the invention to a double furnace, such as a Casson-Dormoy, and work with a Griffith or similar machine, as by that means a still further saving will be effected.—*Iron.*

TESTS OF THE STRENGTH OF DOVETAIL JOINTS.

The following experiments, given in the *Railroad Gazette*, were made at the United States Harbor of Refuge on Lake Huron at Sand Beach, Mich., to determine the relative holding power of different forms of dovetails used in locking timber walls together by means of timber ties. The apparatus used consisted of a pair of 7-ton hydraulic jacks and a 10-ton Duckham hydraulic weighing-machine, with suitable frame and connections. It was found by trial that 6-in. square timber would be the largest scale on which it would be practicable to work with the apparatus at hand.

All the tests were made upon undressed white pine timber of that size. The dovetails were framed upon pieces 2 in. long, the dovetail the full depth of the stick. This short tie was secured between two pieces, each 6 in. long, in *gains* halved out, and fitted to secure it. Bolts were driven through both sticks on each side of the tie, 6 in. from it, as shown in the cut.



The strain was then applied to the tie in the direction of the arrow, and was resisted on the wall timbers at points 15 in. on each side of the tie. The form of the dovetail was modified for different experiments; the fractions refer to the portion of the width cut out at the neck of the dovetail; S for the single, D for the double form.

The following results were obtained from 36 tests: That the strongest form of single dovetail is ⅓ S, which resisted up to 6 tons strain; that the strongest form of double dovetail is ⅙ D—resistance, 6.45 tons; that the double is stronger than the single form; that a ⅙ D loses less from looseness at the point than at the neck; that it is stronger for being tightly fitted; that the position of the bolts does not materially affect the strength; that smoothing the back of a single dovetail increases its strength.

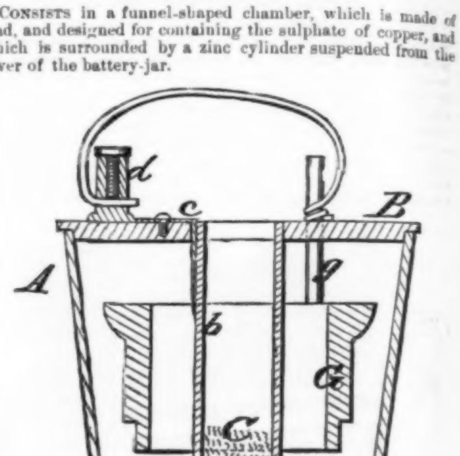
C. P. Gilbert, Assistant Engineer in Charge.

June, 1876.

IMPROVED GALVANIC BATTERY.

By J. E. Watson, Louisville, Ky.

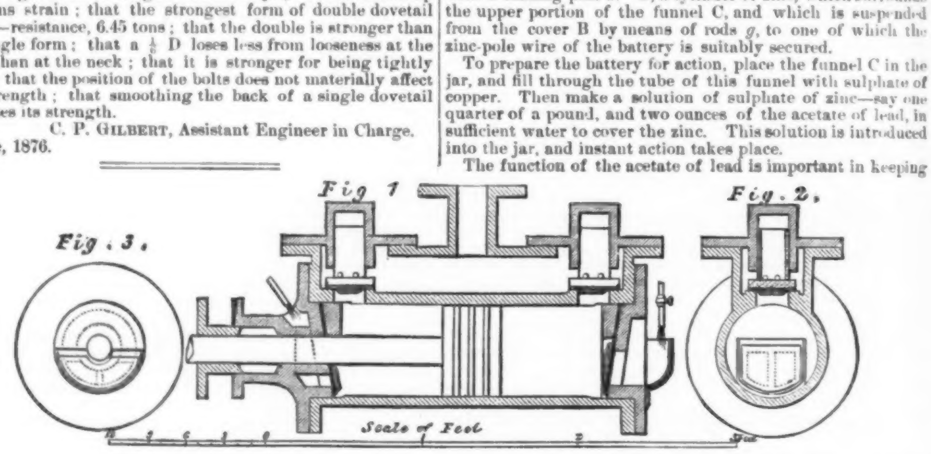
Consists in a funnel-shaped chamber, which is made of lead, and designed for containing the sulphate of copper, and which is surrounded by a zinc cylinder suspended from the cover of the battery-jar.



A glass jar of any suitable size and shape, with a wooden cover, B. C, a funnel, consisting of the conical portion *a*, thickly perforated, and the cylindrical neck or tube *b*. This is made of lead, and the external surface of its tube *b* is coated with shellac to prevent the zinc or lead salt adhering to it. The bottom of the cone *a* fits snugly upon the bottom of the jar A, and the upper end of the cylindrical tube *b* passes through the cover B, and may be provided with a stopple. The funnel is attached to the cover B by means of a copper strip, *c*, which forms an electrical communication with a binding-post *d*. G, a cylinder of zinc, which surrounds the upper portion of the funnel C, and which is suspended from the cover B by means of rods *g*, to one of which the zinc-pole wire of the battery is suitably secured.

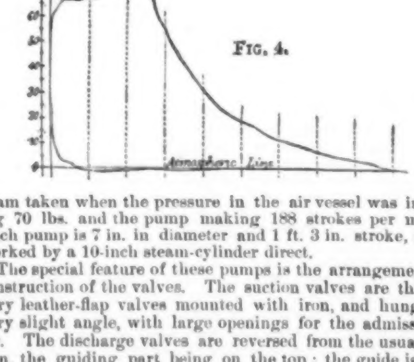
To prepare the battery for action, place the funnel C in the jar, and fill through the tube of this funnel with sulphate of copper. Then make a solution of sulphate of zinc—say one quarter of a pound, and two ounces of the acetate of lead, in sufficient water to cover the zinc. This solution is introduced into the jar, and instant action takes place.

The function of the acetate of lead is important in keeping the metallic surface of the lead funnel in condition to receive the deposit of metallic copper, with which it will, therefore, become coated, and will serve as the copper pole of the battery.



NEW AIR-PUMP.

We illustrate above an air-forcing pump designed by Mr. R. Wyllie, of Hebburn-on-Tyne, for pumping acid to cisterns at a height of 80 ft. Three pumps of the above design have been working for three years, night and day, at pressures on the air vessel registering from 70 lbs. to 100 lbs. per square inch, the valves only requiring new leathers once every three or four months, and the only other wearing part being the guide of the discharge valve. Mr. Wyllie informs us that it has never been required to re-face the metal faces. In our engravings Fig. 1 is a sectional elevation; Fig. 2 is a cross section showing the back-suction and discharge valves; Fig. 3 is an elevation showing the formation of suction valve at the front end of pump, while Fig. 4, subjoined, is a copy of dia-



gram taken when the pressure in the air vessel was indicating 70 lbs. and the pump making 188 strokes per minute. Each pump is 7 in. in diameter and 1 ft. 3 in. stroke, and is worked by a 10-inch steam-cylinder direct.

The special feature of these pumps is the arrangement and construction of the valves. The suction valves are the ordinary leather-flap valves mounted with iron, and hung at a very slight angle, with large openings for the admission of air. The discharge valves are reversed from the usual position, the guiding part being on the top; the guide is made tubular for the sake of better wear and a steadier work, a few holes being required to be made at the back of the disc to prevent the valve from being retarded in its action by any vacuum being formed in the guide. The face of the valve is mounted with a leather disc, which is fixed to the brass valve by an iron plate and rivets. The valve seat is simply the discharge opening faced up. The pump is kept cool by the admission of a small jet of water running into the small chambers formed outside of the suction valves, this water at the same time most effectually protecting the leather from the action of heat. The diagram is a good one.—*Engineering.*

ACTION OF ZINC ON SOLUTIONS OF COBALT.

By M. Lecoq de Boisbaudran.

It is correctly supposed that the salts of cobalt are not precipitated by zinc, whether in the cold or at a boiling heat. Nevertheless, sometimes considerable quantities of zinc are found in the metallic sponge produced by the action of zinc upon the solution of blende in *aqua regia*. The following observations have been made as to the cause of this peculiarity: The presence of a metal readily reduced by zinc is necessary. Copper and lead may carry down cobalt, especially the former. Cadmium gives only negative results. If the liquid containing copper and cobalt is very acid the copper alone is deposited. It is only in liquids bordering closely upon neutrality that the deposition of copper induces that of cobalt also, when the liquid is quickly decolorized. In a solution rendered basic by prolonged contact with zinc cobalt, far from being reduced, is redissolved if it has been previously separated. To decolorize the liquid anew, it is sufficient to add a very small quantity of acid. The cobalt is reduced to the metallic state, and resists dilute acetic acid. Hydrochloric acid attacks the metallic sponge slightly, with evolution of hydrogen, but the action soon ceases. This reaction shows that the copper and cobalt are intimately mixed. A metallic sponge contained four-fifths of its original amount of cobalt after remaining for forty-eight hours in concentrated hydrochloric acid. The presence of a certain amount of a salt of copper is necessary.

USNIC ACID.

By E. Paterno.

The author describes the preparation of usnic acid, to which he assigns the formula $C_{18}H_{16}O_7$, in preference to $C_{18}H_{18}O_7$, as proposed by Hesse and Stenhouse. He further examines its behavior with hydrochloric, nitric, and sulphuric acids; with bromine; with a mixture of sulphuric acid and bichromate of potash; with anhydrous phosphoric acid, zinc turnings, chloride of acetyl, and anhydrous acetic acid; with alcohol, with which, if heated in a closed tube, it yields decarbousnic acid, $C_{18}H_{20}O_6$. The two new accompanying principles are zeorin, $C_{18}H_{22}O$, and sordidin, $C_{18}H_{16}O_7$.

DIRECT TEST FOR CALCIUM IN THE PRESENCE OF BARIUM AND STRONTIUM.

By MALVERN W. ILES, Ph.B., School of Mines, Columbia College.

IN Douglas and Prescott's qualitative analysis, the following is given as a distinctive test for calcium in the presence of barium and strontium:

Ferrocyanide of potassium precipitates ferrocyanide of calcium and potassium, K_2 Ca Cfy, white or yellowish-white, soluble in 800 parts of cold or 145 parts boiling water, which slowly decomposes it, more soluble in dilute than concentrated hydrochl ric acid. Barium and strontium are not precipitated by this reagent.

The reaction will be as follows:

$$Ca\,Cl_2 + 4K\,Cy,\ Fe\,Cy_2 = Ca\,K_2,\ Fe\,Cy_6 + 2K\,Cl.$$

On repeatedly trying the above, no such reaction was obtained, even in strong solutions of calcium chloride; which solutions were much more concentrated than the qualitative student will ever have in the regular course of analysis.

I began a series of experiments, in hopes of modifying this test for qualitative work; since the test, as now stated, I regard as utterly worthless and deceptive. The result of the investigation led to the following modification which is quite delicate.

To the filtrate from the ammonium sulphide group add ammonium chloride, ammonium hydrate, and ammonium carbonate, as usual, slightly wash the precipitate to free it from magnesium salts, which might be present, dissolve the precipitated carbonates upon the filter-paper with as small a quantity of dilute hydrochloric acid as possible. Next add to the hydrochloric acid solution potassium ferrocyanide, then ammonium hydrate, and heat to boiling; a slight precipitate of calcium, strontium, or barium carbonate may occur at this point from the carbonic acid contained in the ammonium hydrate; let the solution nearly cool and add acetic acid to strong acid reaction; if there is any thing more than a trace of calcium present, a white coloration to a yellowish-white soon makes its appearance, generally at the top of the test-tube, soon spreading, however, throughout the entire liquid, and in a few minutes there will subside a white precipitate, rather granular in nature. If, however, only barium and strontium are present, the liquid will become clear, since the carbonates of these metals are soluble in acetic acid.

Owing to the strong affinity of ammonium hydrate for carbonic oxide, which it readily takes from the air, it may be generally assumed a precipitate will occur on the addition of ammonium hydrate to a solution containing either a barium, strontium, or calcium salt. Magnesium salts interfere with this test, hence it should be removed as above indicated. After the addition of acetic acid, care must be taken not to heat the solution, as I find the potassium ferrocyanide is decomposed by acetic acid, at a temperature between 130° and 140° F., and the result is a white coloration that might be easily mistaken for the calcium precipitate.

Frequently after the addition of potassium ferrocyanide and ammonic hydrate to a quite concentrated solution of either barium or strontium chloride, there settles a fine shiny crystalline salt, but which is entirely unlike the white cloud noticed when calcium is present.

Owing to the completeness and the degree of readiness with which calcium separates from a liquid when treated as above indicated, I am inclined to the opinion that the formula, $Ca\,K_2,\ Fe\,Cy_6 + 3\,H_2O$, does not express the true composition of the precipitate in question. If by chemical analysis the salt is found not to be different from the above formula, then potassium calcium ferrocyanide is remarkably insoluble in ammonium acetate, which, it will be noticed, is formed in the mode of procedure given above.

PROPERTIES OF POTASSIUM CALCIUM FERROCYANIDE.

Storer states this salt is soluble in 795 parts water at 150° C., and 145 parts boiling water.

Since the solution in boiling water is a different color from that obtained in the cold, and since it yields no precipitate on cooling, decomposition has occurred. The salt is also decomposed by long washing with water. This salt is soluble in dilute hydrochloric acid, but concentrated hydrochloric acid precipitates it unchanged. It is soluble in nitric acid (sp. gr. 1, 2. Mosander). Insoluble in ammonium chloride (H. Rose, *Tr.*)

RESUME OF TEST.

To a neutral or slightly acid solution that may contain barium, strontium, and calcium, add:

(*a*) $4\,K\,Cy,\ Fe\,Cy_2 + NH_4\,HO$—heat to boiling, and let nearly cool.

(*b*) Add $H\,C_2\,H_3\,O_2$ to strong acid reaction; a white precipitate indicates calcium.

CONCENTRATED SOLUTION OF SALICYLIC ACID.

By C. L. MITCHELL.

A STRONG solution of salicylic acid, for convenience in both dispensing and prescribing, has long been a desideratum, and until recently no practical way of overcoming the difficulty has been known.

Salicylic acid itself is very sparingly soluble in cold water, and though readily dissolving by the aid of heat, nearly all separates on cooling. Its alcoholic solution is not adaptable to the purpose—for when diluted with water, the acid immediately separates.

Various methods have been recommended for rendering the acid more soluble—namely: the use of various salts, such as sodium orthophosphate, calcium chloride, ammonium acetate, etc.; and also by dissolving it in glycerin. None of these modes of procedure give a solution which contains more than ½ per cent salicylic acid. The desideratum seems to be a concentrated solution which will bear dilution with water to any extent. Recently, a writer in the *Druggists' Circular* has recommended the use of sodium biborate and glycerin in the proportions of 1 part each of salicylic acid and the biborate to 16 parts glycerin. This gives a solution containing about 6 per cent salicylic acid, and is freely miscible with water in all proportions.

While recently experimenting with this formula, it occurred to the writer that probably a still stronger and more concentrated solution might be obtained by some slight modifications. After several experiments the following formula was adduced:

Acid, salicylic, pur.......................ʒ ij
Sodii biborat..............................ʒ j
Glycerinæ..................................q. s.

Mix the acid and borax with f ʒ iv glycerin, heat gently until dissolved, then add q. s. glycerin to make the measure f ℥ i. This solution contains 25 per cent salicylic acid, and can be diluted with either glycerin, alcohol or water to any degree desired.

The advantages of a concentrated solution of this description can scarcely be overestimated, as it affords a very convenient mode of both prescribing and dispensing salicylic acid.—*Am. Jour. of Pharmacy.*

SALICYLIC ACID.

By CHARLES BECKER.

THE addition of the phosphates of ammonium or sodium has been recommended to increase the solubility of salicylic acid in water, but these agents really amount to but very little, as a solvent of one part of the acid in three of either phosphate, and fifty parts (by weight) of water throws down a precipitate in less than twenty-four hours. An addition of two parts of sulphite of sodium to one of salicylic acid, in fifty parts of water, precipitates in a few hours. Borax, in the proportion of two parts to one of salicylic acid, and fifty of water, precipitates slightly after twenty-four hours; a solution of one part each of salicylic acid and borax, in five parts of glycerin and twenty-five of water, is permanent; while the same proportion of borax, acid and glycerin, in fifty parts of water, will precipitate after twenty-four hours. A solution of one part of acid to two of borax, in twelve parts of glycerin, made with heat, is permanent; but when one part of this solution is diluted with three parts of water, which makes it two parts of salicylic acid, four of borax, twenty-four of glycerin and ninety of water, a cloudiness appears in a few hours. One part of salicylic acid with one part of water of ammonia (20°) forms with ten parts of water a permanent solution; this has a light-brownish color, a very faint odor of ammonia, a very distinct, sweet taste of the acid, and a slight acid reaction on litmus paper.

Salicylic acid is soluble in ten times its weight of dilute alcohol, at a temperature of about 80° F., in one and a half times its weight of alcohol (0.835 sp. gr.), and in twice its weight of sulphuric ether. It is nearly insoluble in cold oil of turpentine, but hot turpentine dissolves about 5 per cent of its weight. Its alcoholic solution has a decided acid reaction on litmus paper. An addition of one fifth of one per cent of salicylic acid to aqueous infusions will preserve them for weeks; and the same proportion added to syrups made with fruit juices, while it will not arrest fermentation after such has set in, will prevent the same.

The acid used in the above experiments was of Schering's make, and perfectly white and inodorous.

When one part of salicylic acid and two parts of olive-oil are heated together they form a homogeneous mixture, admirably adapted for application to surfaces. The oil will separate to some extent on standing for a time, but agitation will easily combine it again.—*Am. Jour. of Pharmacy.*

NEW PROCESS FOR DETERMINING ASTRINGENTS.

By M. F. JEAN.

THE author has observed that astringents mixed with an alkaline carbonate absorb the solution of iodine with a readiness like that of the arsenite of soda. This absorption is directly proportional to the quantity of astringent matter present. 1 part of dry tannic acid taking up 4 parts of iodine. The solution of iodine required for the titration of tannin is obtained by dissolving 4 grms. of iodine in iodide of potassium, and making up the solution to 1000 c.c. with distilled water. To standardize this solution, place in a precipitating glass 10 c.c. of a solution of tannin containing 0.1 grm. per cent, add 2 c.c. of an alkaline solution containing 25 per cent of crystalline carbonate of soda, and then with a graduated burette drop the solution of iodine into this mixed liquid till a drop of the mixture, taken up with the stirring-rod, and placed upon a leaf of starch-paper, produces a very slight violet spot, which indicates the presence of free iodine and the end of the operation. The value thus obtained must be corrected—that is to say, from the number of c.c. of solution of iodine corresponding to 0.1 grm. of tannin must be deducted the volume of the solution required to produce the colored reaction upon starched paper. For this purpose 10 c.c. of distilled water are measured out, mixed with 2 c.c. of alkaline solution, and the solution of iodine is then added, drop by drop, till a spot is obtained upon the starched paper. With a solution containing 4 grms. iodine per litre the correction is generally 0.1 c.c. for a volume of 10 to 12 c.c., but the greater or less purity of the carbonate of soda may make a slight variation in this correction. To 0.01 grm. of tannin dissolved in 10 c.c. of water it is generally necessary to take 10.5 c.c. of a solution at 4 per 1000. The paper used is white filter-paper, covered by friction with a slight layer of powdered starch. For ordinary determinations tannic-acid may be taken as the type of the active principle of astringent bodies. But if a high degree of accuracy is required, the solution should be standardized with a pure sample of the astringent body under examination, catechuic acid being used in case of catechu, morintannic acid for fustic, etc. Crystalline gallic acid decomposes the solution of iodine in the same proportion as tannic acid. If it is desired to determine these acids separately, we first find the joint amount of tannic and gallic acids, and then, operating on a fresh portion, remove the tannic acid by means of rasped hide or gelatin and alcohol, and determine afresh the gallic acid remaining. The tannic acid is then found by subtracting the second result from the first. The extractive matters found in astringents do not interfere.

RUSTING OF IRON.

By A. WAGNER.

DETAILS are given of experiments made upon strips of iron which were acted upon by water containing various salts, in presence of air free from carbon dioxide, and of air containing that gas at various temperatures, and also in sealed tubes, from which air was expelled.

The general results were that pure water in presence of air causes iron to rust; that if carbon dioxide is also present, the rusting is more rapid; that the production of rust is materially increased by the chlorides of magnesium, ammonium, sodium, potassium, barium and calcium, the first mentioned being most active in this respect; that iron immersed in evaporated river-water rusts more slowly than iron in distilled water; that the presence of oils or fats greatly diminishes the rapidity of rusting; that alkalies prevent the rusting entirely. Magnesium chloride solution, in the absence of air, attacked iron at a temperature of about 100°; chlorides of sodium, potassium, barium and calcium were without action under the same circumstances. The original paper must be consulted for details and measurements.—*Jour. Chem. Soc.* [Lond.]

METALLIC CERIUM, LANTHANUM, AND DIDYMIUM.

DRS. HILLEBRAND AND NORTON, in Bunsen's laboratory, have obtained, by the electrolysis of the cerium, lanthanum and didymium chlorides, the metals in quantities sufficient for careful investigation. As proof of the purity of the materials employed they refer to the methods of separation given by Bunsen (*Pogg. Ann.*, clv 366).

CERIUM.

Metallic cerium has the color and lustre of iron; it slowly tarnishes in dry air, and in moist air soon changes color, as steel does when heated, to yellow, blue, and gray. After fusion it has the hardness of calcite, and is malleable and very ductile. The specific gravity of the electrolytic metal is 6.628, and after fusion under salt and potassium chloride it is 6.728. The low specific gravity found for cerium reduced by sodium 5.5 indicates that it contained sodium. The melting point of cerium is lower than that of silver, and considerably higher than that of antimony. Its kindling temperature in air and oxygen is much lower than that of magnesium. Pieces scratched off inflame, and the wire ignited in a flame burns more brilliantly than magnesium wire. It burns when heated in chlorine, less readily in bromine vapor, and without incandescence in iodine vapor. Water at common temperatures is slowly decomposed by it; cold concentrated sulphuric acid and cold red fuming nitric acid do not attack it, but these acids when dilute, and also hydrochloric acid, dissolve it.

LANTHANUM.

Metallic lanthanum is much like cerium in its general chemical deportment, but by concentrating nitric acid it is easily attacked. It is slightly harder and less ductile than cerium; it is less permanent in air, and even in dry air its color soon changes to a steel blue. The specific gravity of a piece deposited by electrolysis weighing 7.6 grammes was 6.163; after fusion it was less, 6.049. Its melting point appears to be near that of cerium, and its kindling temperature is higher. Small pieces from filing or striking on flint do not ignite spontaneously in the air, but burn brilliantly in the flame. Their analysis shows less than one per cent of impurity in the specimen.

DIDYMIUM.

Metallic didymium is more like lanthanum than cerium; it is not less lustrous, ductile or permanent in air than lanthanum, and has about the same hardness; its color is not as white, and moist air turns it yellow. Fine particles of the metal do not ignite spontaneously in the air, but burn when heated in a lamp flame. It is less fusible than either lanthanum or cerium, and the metal after fusion has a specific gravity of 6.544.—*Pogg. Ann.*

ANILINE GREEN IN TISSUES WITH COTTON WARP.

BY preparing the tissues with sumach and salt of tin, they may be dyed in a solution of aniline green, but such dyeing in general wants body, and the tint is too bright for this kind of fabric. In practice these greens are generally obtained by first giving the cotton a tint of Prussian blue, and the wool one of indigo, and bringing them towards green by means of yellow wood or quercitron. The alkaline blues, called "Nicholson's blues," produce those tints more simply, for these blues take well on cotton; still, as the wool takes the color much more rapidly, it is well to mordant slightly with sumach or alum.

The following is the method recommended: For 10 kilogrammes of tissue, steep it for five or six hours in a decoction of 2 kilogrammes of sumach, then pass it cold through a solution of 1 kilogramme of alum. Then the dye vat being prepared with borax and Nicholson's blue, as for woollens, commence dyeing at tepid heat, and keep it 30 to 45 minutes with the temperature but slightly heated. During this time the cotton will take more than the wool. When the required tint is nearly obtained then the heat must be raised, in order that the color may be solid throughout.

In order to ascertain, if it be so, a small sample is steeped in very weak sulphuric acid, and the brightening of the blue furnishes the test.

After the fabrics are withdrawn from the blue dye they are well drained, and then steeped in a solution of 2 kilogrammes of alum, and 100 grammes of flavine. Dye tepid until the cotton seems sufficiently tinted, then raise the heat, and add cream of tartar 2 kilogrammes, and flavine 100 grammes. Immerse and boil till the tint required is obtained. The color, which before was dull and gray, is developed and rendered brilliant by this last operation. Finish by rinsing.—*Moniteur des Fils et Tissus.*

METALLIC GLOSS FOR DYED FABRICS.

WITH various varieties of goods and stuffs, it is often desired to give them a certain lustre or metallic gloss. A number of processes have already been introduced in the finishing treatment of such goods. The present receipt (recommended by the *Centralblatt für die Textil Industrie*) distinguishes itself by its adaptability to woollen and cotton fabrics, and by its ensuring better and handsomer results. Inasmuch as the glossing or lustreing takes place with the dye manipulation, this process may likewise be said to be considerably cheaper than other processes. Supposing that the fabric to be treated is to receive a black or brown metal gloss, the treatment is as follows, after having damped the material with a weak solution of soda.

Two cloth pieces, black, 35 *lbs.*—Having dissolved 12 lbs. of green vitriol, 3 lbs. of blue vitriol, and 23 lbs. of pyrotartaric acid in a pan, the pieces are dipped in and allowed to boil well for one half hour. The cloth is next taken to the washing machine, or, better, to running water, and then dyed in the usual way in logwood, etc. After rinsing, the cloth is next dipped into a warm bath (65 deg., 88 deg. C.), composed of 5 lbs. blue vitriol, dissolved in 12 lbs. of ammonia, with the necessary quantity of water. After rinsing once more, the cloth is changed to a hyposulphite of soda solution (10 lbs. of hyposulphite of 1200 specific gravity, with the addition of water), after which it is taken out, washed, and finished in the usual manner. The cloth may be allowed to remain one quarter of an hour in each of the two last-mentioned baths.

If a brown metallic gloss be desired, the cloth is dyed to pattern, washed and passed through two baths of blue vitriol, dissolved in ammonia, and removed to the hyposulphuric soda solution. In cases where the metallic gloss is to be gray, lavender blue, or of other similar colors, in place of the copper salt, substitute a lead, zinc, or silver salt, allowing the fabric to be likewise latterly subjected to the hyposulphuric soda solution.

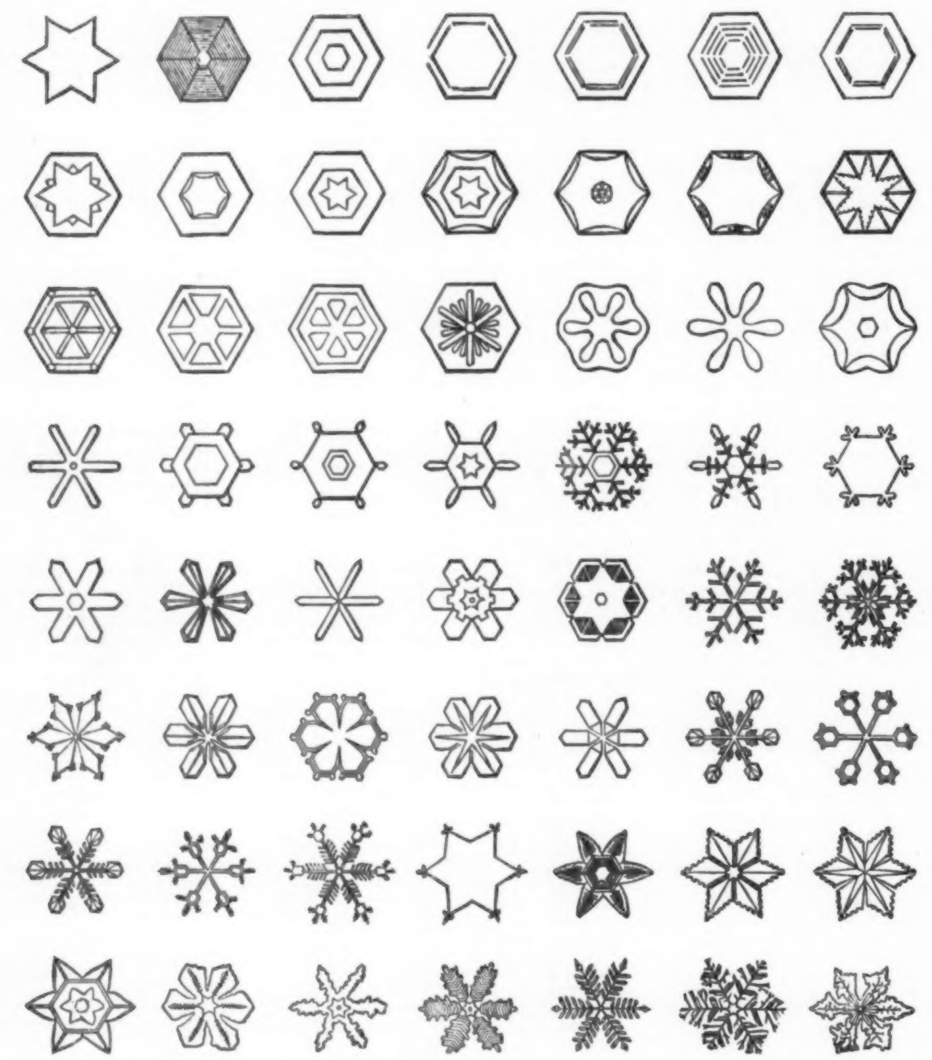
THE ARTIFICIAL PRODUCTION OF THE CRYSTALLINE FORMATION OF SNOW.

The numerous forms assumed by snow-flakes have been divided by Scoresby into five principal types: 1. Small thin plates appearing sometimes as stars, sometimes as simple hexagons, and again as composite figures, six-sided, and with or without points. 2. Forms which have branched points in divers planes, and a flat or spherical nucleus in the middle. 3. Fine needles or six-faced prisms. 4. Six-faced pyramids. 5. Needles or prisms affixed by one or both extremities to the middle of thin leaves.

Snow-crystals are, however, extremely fugitive, and therefore difficult to study. It is, of course, impossible to retain them in the shape of a microscopical preparation, and therefore it has been the object of crystallographers to discover some material which would crystallize in manner similar to snow, so that the crystals of the latter could thus be studied through the analogy.

M. Jean Dogiel communicates to *La Nature* a paper in which he states that iodoform answers the above requirement. This body was discovered by Dumas in 1834, and has the formula $C\,H\,I^3$. Serullas has obtained it in form of a yellow crystalline body by treating the alcoholic solution of iodine with a potash lye.

Iodoform does not decompose with the same facility in ether or chloroform as in alcohol. A solution of iodine in ether, however, treated with a potash or ammonia lye, gives iodoform as before. The iodoform used by M. Dogiel was prepared as first stated above. It crystallizes in the hexagonal and not in the rhomboidal system, and has but one optic axis.



IODOFORM CRYSTALS RESEMBLING SNOW.

Contrary to salts, which produce simple crystals of few forms, those produced by iodoform are extremely rich in varieties. Generally they are engendered in microscopic volume, and do not exhibit their varied shapes until the iodoform is disengaged from its solutions under special conditions. The influence that the unequal rapidity of formation exercises on the form, volume, and perfection of the simple and compound crystals, is great. This can easily be observed by dissolving iodoform in alcohol boiling at 194° Fah., and allowing the solution to cool in water at different temperatures. M. Dogiel has found that the table form of crystals was predominant when the hot alcoholic solution contained in the test tube (the solution holding from 15 to 30 per cent of iodoform) was placed for ten minutes in water at from 57° to 59° Fah. On the contrary, groups of crystals stellar-shaped, and often very complicated, were produced when the water had a temperature of 88° Fah. The formation of crystals may be hastened or retarded according as a greater or less quantity of distilled water is added to the iodoform solution. Alcohol is employed instead of water when the iodoform has been dissolved in ether. Forms greatly differing from each other may also be produced by the more or less rapid evaporation of the iodoform solutions, or by the reciprocal reaction of solutions of potash and of iodine of different concentration. When the crystallization is rapid only irregular crystalline granules are obtained.

In order to show the rich variety of forms and their striking resemblance to those impressed by nature upon the snow-flake, M. Dogiel has prepared the drawing given herewith.

METEOROLOGY.

We abstract the following from a paper by Prof. Loomis in *The American Journal of Science and Arts:*

A great diurnal change of temperature is most common at stations near the eastern slope of the Rocky Mountains. The cold wave makes its first appearance in this region and the intensity of the cold is sensibly diminished as the wave travels eastward. An example illustrating the variable climate of the eastern slope of the Rocky Mountains occurred Dec. 24th, 1872. Denver was at that time on the borders of the cold area which prevailed from the Rocky Mountains to Nova Scotia, and during the night of the 23d and 24th the thermometer fell to 2°. During the 24th, Denver began to feel the influence of the storm which was advancing from Oregon, and on that day the thermometer rose to 55°, showing a change of 53° in a day, and probably the entire change took place in less than 24 hours. Similar cases must frequently occur near the eastern slope of the Rocky Mountains, and the changes of temperature are more sudden here than they are near the Atlantic coast, because the cold which succeeds a storm is more intense than it is in the eastern portions of the United States.

Whenever an area of low barometer is formed in the United States, we may be tolerably sure that there exists at the same time an area of high barometer at a distance of about 1200 miles, and in a direction a little south of east.

In Europe as well as in the United States this forming process takes place chiefly on the southeast side of an area of low pressure. The comparisons which I have made also indicate that in Europe the direction of the high area from the low area is more southerly than it is in the United States, and the distance sensibly greater.

Low barometer is generally associated with high temperature, and high barometer with low temperature. Hence we should conclude that a temperature above the mean in Iceland would be accompanied by a temperature below the mean in Central Europe.

When the temperature of Iceland is much *above* the mean, the temperature of Central Europe is generally depressed *below* the mean, and this influence is most decided during the colder months of the year.

The results obtained for the United States and for Europe suggest the idea that an area of unusually high barometer in the central portion of North America may be the result of a storm prevailing at a distance of 1500 or 2000 miles in a northwest direction. Upon referring to a map we find that the Aleutian Islands are situated in this direction, and at a distance of about 2000 miles from Oregon, and we know that in the neighborhood of these Islands the storms of winter are unusually severe and the barometer often sinks extremely low. If we had maps showing the isobaric curves from day to day in the vicinity of the Aleutian Islands, and extending to the central portions of North America, it is presumed we should find that low pressure near these Islands was generally attended by an area of high pressure in a southeast direction at a distance of 1500 or 2000 miles.

In the course of last year the Northern Central Railroad Company laid 6623 tons of steel rails for renewal purposes.

ICE IN GREAT BRITAIN.

Prof. Ralph Richardson gives the facts with regard to the shallow depths of ocean between Great Britain and Iceland and Greenland on one side and over the German Ocean on the other, and presents reasons for believing that there was dry land over the region in the Glacial era; that the glaciers of Great Britain came over this emerged land from the north and West; and that the cold of the Glacial era was due in part at least to the closing thus of the Arctic, and excluding thereby the Gulf Stream. The facts appear to sustain the conclusions. The depth between Britain and Iceland mostly does not exceed 100 fathoms, and nowhere exceeds 1,000; and one tract of sea extending in a straight line from the eastern coast of Greenland *via* Iceland and Faroe to Scotland does not exceed 500 fathoms. The depth of the sea in the English Channel is only about 20 fathoms, and the average depth of the North Sea or German Ocean is not over 40 fathoms or 240 feet. The depth between Britain and Greenland is small compared with the average depth of the Atlantic. The author closes with the conclusion, that one of the oscillations of level, such as have often occurred over the earth's surface, had the effect to "unite Britain and Northern Europe with Greenland and the Arctic regions;" to give the polar ice-fields access to Europe;" "to divert the course of the Gulf Steam and free Northwestern Europe from its influence; and, in conjunction probably with some diminution in the influence of the sun, to produce a Glacial epoch."

ELECTRO-MAGNETIC ROTATIONS.

Mr. W. Spottiswoode in a recent communication to the Royal Society discusses the phenomenon known as the rotating spark. A powerful magnet being brought near the spark the latter is seen to assume a spiral form which is right-handed or left-handed according to the direction of the current and of the magnetic polarity. The spark was passed between the poles of an electro-magnet and the effect on the form of the discharge caused by exciting the magnet was observed. For this purpose the movable poles were insulated from the main body of the magnet by interposing a sheet of ebonite thick enough to prevent the passage of the spark.

The discharge, as is well known, consists of two parts, the spark proper and a bright cloud or flame surrounding it, which may be thrown to one side by a current of air. The spark is but little affected by the magnet, but the flame is at once spread out into a sheet forming a right or left-handed helicoid according to the direction of the current, and following Ampère's law. Similar effects were obtained with other gases and at other pressures. The brilliancy may be increased by attaching a piece of sodium to the negative terminal, or by causing a stream of any of the volatile chlorides to flow across the field of action. The following explanation is due to Prof. Stokes. Supposing the magnetic field to be uniform, the lines of force will be straight lines from pole to pole. In such a condition every thing being symmetrical, no rotation would take place. But if through any local circumstance the path of the current be distorted or displaced, then each element will be subject to two forces, one tending to turn the current around the axis, the other tending to make it follow the shortest path so as to diminish the resistance.

The general nature of the phenomenon may be described as follows: First, we have the bright spark of no sensible duration which strikes nearly in a straight line between the terminals. This opens a path for the continuous discharge, which being nearly in a condition of equilibrium, though an untranslatable one, remains a short time without much change of place. Then it moves rapidly to its position of equilibrium, the surface which is its locus forming the sheet. Then it remains in its position of equilibrium during the greater part of the discharge, approaching the axis again as the discharge falls, so that its equilibrium position is not so far from the axis. Thus we see two bright curves corresponding to the two positions of approximate rest united by a less bright sheet; the first curve lies nearly in a straight line and the second nearly in a helix traced on a cylinder of which the former line is a generating line. The appearance of the discharge when viewed in a revolving mirror confirms the above remarks.—*Nature.*

LIQUID FILMS.

Dr. Sondhauss has extended the observations of Plateau on liquid films to the determination of the extent to which different liquids can be stretched in wire rings. He observed the lamellæ in closed vessels excluding external disturbances, measured with a balance their tension and with a manometer the pressure of bubbles on the enclosed air; he also measured the weight of such lamellæ and bubbles, whence their thickness might be inferred. With a simple contrivance consisting of a thin wire bent horizontally to an angle, and a straight wire placed across and drawn gradually away from the angle, it may be shown that all liquids may be stretched in lamellæ, and that different liquids may be compared in this respect. But Dr. Sondhauss prefers the circular wire rings, and compares (as to size) the films of forty-six different liquids. One film from a guillaja decoction, to which a little glycerine had been added, lasted over half a year.—*Nature.*

THE ELECTRIC LIGHT.

Mr. M. V. Serrin states that in certain electric experiments, particularly regulators for electric-light machines giving a light equal to 3000 carcel burners, the wires of electro-magnets employed are so intensely heated that the insulating material is burnt and destroyed. To obviate this, the helices of the electro-magnets are entirely uncovered with any insulating material, but the convolutions are so far apart that they are insulated by the air.

With this arrangement the helices can be brought to an intense heat without the convolutions losing their insulations, since they do not touch. Indeed, they have been made red-hot without a sensible change in the instrument.

TINNING OF METALS.

For plating various metals, for example, iron, steel, brass, lead, and zinc, M. Vegler recommends the following process: Prepare a solution of perchloride of tin by passing chlorine through a concentrated solution of salt tin. Dilute the product by 8 to 10 times its volume of water, and filter, if necessary. The article, half scoured with sulphuric acid, is to be polished with sand and the scratch-brush; then washed with water, and hung by a zinc wire for 10 or 15 minutes in the solution of perchloride of tin. Afterwards take it out, rub it with the scratch-brush, dry it, and polish it.—*Revue Industrielle.*